

CAYON HBL178  
76H16

HAMILTON  
RAPID TRANSIT  
DEVELOPMENT  
PROGRAMME



PHASE III - Stage I

# RECOMMENDED PRIORITY CORRIDOR WITHIN THE BASIC TRUNK NETWORK

September 1976



HAMILTON TRANSIT STUDY COMMITTEE

TECHNICAL ADVISORY COMMITTEE

Phase III, Stage 1

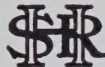
|                 |                                                  |
|-----------------|--------------------------------------------------|
| R.A. Ballantine | Ministry of Transportation<br>and Communications |
| R.J. Desjardins | City of Hamilton                                 |
| H. Donnelly     | Ministry of Transportation<br>and Communications |
| E. Havelka      | City of Hamilton                                 |
| J.A. Little     | Hamilton Street Railway<br>Company               |
| G. McCarthy     | Regional Municipality of<br>Hamilton-Wentworth   |
| B. McGaffigan   | Ministry of Transportation<br>and Communications |
| E.S. Moore      | Hamilton Street Railway<br>Company               |
| D.W. Roughley   | Regional Municipality of<br>Hamilton-Wentworth   |
| W. Smith        | Hamilton Street Railway<br>Company               |

F.A. Cooke (Chairman)  
Hamilton Street Railway Company



# The Hamilton Street Railway Company

18 Wentworth St. N.



Founded 1873

Hamilton, Ontario L8L 5V1

The Honourable James W. Snow,  
Minister of Transportation & Communications,  
Ontario,

and

Mr. J. Jaskula,  
Chairman, Hamilton Transit Commission.

Gentlemen:

The Hamilton Transit Study Committee has now completed the task assigned to it as Phase III - Stage I (Rapid Transit Development) in the continuing series of Studies commenced in 1969 for long-range transit planning.

The report of the Consortium of Consultants has been received and is summarized in this volume.

The Study Committee has reviewed interim reports and the final report carefully and endorses the subject matter and findings. In so doing, the Committee wishes to place before you the following recommendations for your consideration:

1. The findings of this Study be used in the development of land use and transportation policies in the Regional and Hamilton Official Plans.
2. Consideration of Phase III - Stage 2 be deferred until such time as a development policy of a high level of employment in the CBD is confirmed.

Yours very truly,

F. A. Cooke  
Chairman

THE HAMILTON TRANSIT STUDY COMMITTEE

Hamilton, Ontario  
August 31, 1976.

# rapid transit development programme

DE LEUW - DILLON - IBI GROUP

149 MAIN STREET EAST, HAMILTON L8N 1G4 (416) 525-5085

Mr. F. A. Cooke, Chairman, and  
Members of the Technical Advisory Committee,  
Hamilton Rapid Transit Development Programme,  
18 Wentworth Street North,  
HAMILTON, Ontario, L8L 5V1.

Gentlemen:

Re: Hamilton Rapid Transit Development Programme  
Phase III, Stage I

The accompanying report is submitted in accordance with our agreement with the City of Hamilton dated April 10, 1975.

The report outlines a basic trunk rapid transit network and the priority corridor for implementation to respond to the growing need for public transit improvements as the Region of Hamilton-Wentworth grows toward a population of 595,000.

We believe the findings in this report identify the implications of the population and employment growth options on the transportation requirements in the major travel corridors and point out the role for exclusive right-of-way transit facilities in meeting this demand. In addition, the information presented offers direction in the formulation of transportation policy as part of the Official Plan preparation.

We acknowledge the co-operation and assistance provided throughout the study by the Technical Advisory Committee, the Hamilton Street Railway Company and the technical departments of the City.

The opportunity of participating in this important programme is greatly appreciated and we trust the findings will contribute toward the introduction of exclusive right-of-way transit in the City of Hamilton.

Yours very truly,

DE LEUW - DILLON - IBI GROUP,

E. S. Fisher,  
Project Director.

ESF:DT:mc

D. Turvey,  
Project Co-ordinator.







PHASE III – Stage I

---

# RECOMMENDED PRIORITY CORRIDOR WITHIN THE BASIC TRUNK NETWORK

---

September 1976





Digitized by the Internet Archive  
in 2026 with funding from  
Hamilton Public Library

<https://archive.org/details/32022213352681>

# TABLE OF CONTENTS

|                                                         | PAGE |                                                  | PAGE |
|---------------------------------------------------------|------|--------------------------------------------------|------|
| 1 SUMMARY                                               |      | 5 EFFECT OF BASIC NETWORK ON TRAVEL DEMANDS      |      |
| 1.1 Scope of the Work                                   | 1    | 5.1 Approach                                     | 33   |
| 1.2 Organization and General Approach                   | 1    | 5.2 Transit Demands                              | 33   |
| 1.3 The Report                                          | 4    | 5.3 Road Requirements                            | 34   |
| 1.4 Study Findings - Phase III, Stage 1                 | 5    | 5.4 Discussion of Projected Transit Usage Levels | 34   |
| 2 STUDY BACKGROUND AND CHARACTERISTICS OF RAPID TRANSIT |      | 5.5 Summary                                      | 39   |
| 2.1 The Rapid Transit Development Programme             | 11   | 6 PRIORITY CORRIDOR SELECTION                    |      |
| 2.2 The Characteristics of Rapid Transit                | 12   | 6.1 Evaluation Method                            | 40   |
| 3 FUTURE GROWTH AND TRAVEL DEMAND                       |      | 6.2 Corridor Evaluation                          | 44   |
| 3.1 Future Growth Projections                           | 13   | 6.3 Selection of Priority Corridor               | 54   |
| 3.2 Development Strategies                              | 15   | 7 TECHNOLOGY REVIEW                              |      |
| 3.3 Travel Demand Estimates                             | 16   | 7.1 Description of Existing Technologies         | 55   |
| 3.4 Activity Areas                                      | 23   | 7.2 Comparison of System Characteristics         | 58   |
| 3.5 Inter-regional Transit                              | 23   | 7.3 Broad Performance Specifications             | 58   |
| 4 IDENTIFICATION OF BASIC RAPID TRANSIT NETWORK         |      |                                                  |      |
| 4.1 General Approach                                    | 24   |                                                  |      |
| 4.2 Preliminary Screening                               | 24   |                                                  |      |
| 4.3 Testing of Network Options                          | 27   |                                                  |      |
| 4.4 Selection of Basic Network                          | 27   |                                                  |      |

## APPENDICES

|                            |     |
|----------------------------|-----|
| A INDEX OF INTERIM REPORTS | A-1 |
| B PUBLIC PARTICIPATION     | B-1 |



## LIST OF TABLES

|                                                               | PAGE |
|---------------------------------------------------------------|------|
| 1.1 Summary of Findings; Phase III, Stage 1                   | 2,3  |
| 1.2 Summary of Corridor Evaluation                            | 9    |
| 3.1 Summary of Past Population and Employment Forecasts       | 14   |
| 3.2 Population and Employment Estimates                       | 17   |
| 5.1 Transit Estimates for Basic Network                       | 35   |
| 5.2 Estimates of Road Requirements                            | 36   |
| 6.1 Summary of Corridor Evaluation                            | 45   |
| 6.2 Priority Corridor Selection                               | 46   |
| 6.3 Corridor Capital Cost Estimates                           | 52   |
| 7.1 Service Characteristics of Rapid Transit Systems          | 59   |
| 7.2 Typical Physical Characteristics of Rapid Transit Systems | 60   |
| 7.3 Typical Costs for Rapid Transit Systems                   | 61   |
| 7.4 Status of Technology Development in North America         | 62   |
| 7.5 Performance Specifications                                | 63   |

## LIST OF EXHIBITS

|                                                                  | PAGE |
|------------------------------------------------------------------|------|
| 1 Recommended Basic Trunk Network and Selected Priority Corridor | 7    |
| 2 2001 Development Options -- Population Distribution            | 18   |
| 3 2001 Development Options -- Employment Distribution            | 19   |
| 4 Modal Split Relationships                                      | 21   |
| 5 Preliminary Test Network                                       | 25   |
| 6 Alternative Network A                                          | 28   |
| 7 Alternative Network B                                          | 29   |
| 8 Alternative Network C                                          | 30   |
| 9 Road Capacity Deficiencies - 2001                              | 31   |
| 10 Recommended Basic Trunk Network                               | 41   |
| 11 System Classifications and Representative Technologies        | 57   |

# 2. Study background and characteristics of rapid transit

## 2.1 THE RAPID TRANSIT DEVELOPMENT PROGRAMME

*In 1969, the Hamilton Transit Commission and the Ontario Ministry of Transportation and Communications initiated a programme to identify both short-term public transit improvements and long-term rapid transit requirements for the City of Hamilton.*

During 1969, the Work Group of the Hamilton Transit Planning Committee suggested that two studies be undertaken:

- a study to determine ways and means of optimizing the use of present transit equipment;
- a limited study to determine the approximate costs of conventional rapid transit systems which might offer solutions to the transportation problems of Hamilton, particularly the problem of Mountain access.

In 1970, a physical feasibility report was completed. This report indicated it would be physically feasible to construct a rapid transit line to connect the Mountain with the Central Business District and the Bay Front Industrial Area.

During 1972 and 1973, Phase 1 and Phase 2 of the Programme, which involved short-term

transit operational improvements, were completed. The short-term recommendations identified have been implemented.

In 1975, the Hamilton Transit Commission authorized The Hamilton Street Railway Company to move to the next phase of the Hamilton Rapid Transit Development Programme. The phase is planned to have 3 stages as follows:

Stage I - Select the first priority corridor for rapid transit, the subject of this report;

Stage II - Select the route and station locations for the rapid transit line in the priority corridor;

Stage III - Develop a programme for the orderly implementation of revenue service on the first line.

### RAPID TRANSIT PLANNING IN HAMILTON BY OTHER AGENCIES

In 1972, the Provincial Government announced a transportation policy which would promote the upgrading and expansion of urban public transit systems. The announcement included a tentative plan for rapid transit in Toronto, Hamilton and Ottawa.

In 1973, the City of Hamilton carried out the Hamilton Transportation Strategy Study, an investigation of the transportation requirements and implications of a variety of possible development patterns for the Hamilton-Wentworth Region. This study revealed that substantial transportation capacity deficiencies will likely develop in the specific corridors focused on the central area of Hamilton within the next eight to twelve years. It underlined the need to continue with the investigation of providing a rapid transit system to assist in meeting the future transportation requirements.



## 2.2 THE CHARACTERISTICS OF RAPID TRANSIT

The intent of rapid transit is to attract a higher portion of travel within an urban area by offering improved levels of transit service and higher capacity than those systems operating in mixed traffic. By virtue of providing a separate transit right-of-way, the higher operating speeds result in significant reductions in passenger travel time.

The characteristics of conventional urban bus, trolley and streetcar systems are compared in the adjacent table with rapid transit to highlight the major distinctions.

Within the context of rapid transit, there are five basic technology system classifications. These are listed below and described in detail in Section 6 of this report.

- Bus Rapid Transit
- Light Rail Transit
- Automated Guideway Transit
- Monorail Transit
- High Capacity Rapid Transit

| Characteristics                                         | Rapid Transit Systems              | Surface Transit Systems                           |
|---------------------------------------------------------|------------------------------------|---------------------------------------------------|
| Right-of-way requirement                                | Exclusive right-of-way required    | Right-of-way shared with private autos and trucks |
| Maximum capacity<br>(passengers per hour per direction) | 15,000 - 20,000<br>30,000 - 40,000 | 6,000                                             |
| Average system operating speed                          | 25 - 30 m.p.h.                     | 12 - 20 m.p.h.                                    |

# 3. Future growth and travel demand

*This section of the report outlines the population and employment forecasts used to forecast future transit trip demand. The range of development strategies for the allocation of this growth throughout the Hamilton-Wentworth Region and the City of Burlington is described.*

The growth in population and employment will increase travel between the various areas in the Region and in particular will focus the travel demand in a number of specific transportation corridors. As a consequence, the requirement for enlarged transportation systems in the form of additional road facilities and/or higher capacity transit service is expected.

## 3.1 FUTURE GROWTH PROJECTIONS

Travel demands and, in turn, the levels of ridership on rapid transit are directly related to the numbers of people and jobs in an area and their spatial distribution. Accordingly, the starting point in estimating the future ridership on rapid transit is information on the expected growth of the area and its distribution.

A number of projections of population and employment have been prepared for the Hamilton area over the past 15 years. The projections that have been used in previous studies related to transportation are summarized in Table 3.1.

The estimates used in this Study were preliminary figures prepared by the Regional Planning Department developed during the summer of 1975. These estimates take recent trends into account such as the decline in birth rates in the early 1960s and recent immigration trends. The final population forecasts submitted by the Planning Department differ slightly from the preliminary estimates; however, the difference is minor and does not affect the findings given in this report.

## POPULATION

The population estimates provided by the Regional Planning Department for the Rapid Transit Study indicate that the population of the Hamilton-Wentworth Region will increase from about 401,000 in 1971 to approximately 481,000 by 1986 and 595,000 by the year 2001.

The Planning Department of the Region of Halton has prepared a number of projections of population for the City of Burlington, ranging from some 200,000 to approximately 300,000 by the year 2001, compared to approximately 87,000 in 1971. For purposes of the Hamilton Rapid Transit Development Programme, an average of these projections for Burlington was chosen, being 167,000 by 1986 and 244,000 by the year 2001.

## EMPLOYMENT

The employment in the Hamilton-Wentworth area is expected to double from the 1971 level of 153,000 jobs to about 306,000 by the year 2001. This projection is based on an increase in the labour force participation rate (jobs per person) in the Hamilton area. Similarly, the employment level in Burlington is expected to increase from 21,000 jobs in 1971 to 83,000 by the year 2001. A significant increase in employment in the



Table 3.1  
SUMMARY OF PAST POPULATION AND EMPLOYMENT FORECASTS

|            | Hamilton Area<br>Transportation Study - 1963 | Hamilton Transportation<br>Strategy Study - 1973 | Regional Planning Department<br>Hamilton-Wentworth Region - 1975 |
|------------|----------------------------------------------|--------------------------------------------------|------------------------------------------------------------------|
| Population |                                              |                                                  |                                                                  |
| 1961       | 372,000                                      | -                                                | -                                                                |
| 1971       | -                                            | -                                                | 488,000                                                          |
| 1986       | 723,000                                      | 655,000 - 700,000                                | 648,000                                                          |
| 2001       | -                                            | 880,000 - 1,050,000                              | 839,000                                                          |
| Employment |                                              |                                                  |                                                                  |
| 1961       | 125,000                                      | -                                                | -                                                                |
| 1971       | -                                            | -                                                | 174,000                                                          |
| 1986       | 289,000                                      | 303,000 - 326,000                                | 268,000                                                          |
| 2001       | -                                            | 405,000 - 523,000                                | 389,000                                                          |

*Note: Study Area Boundaries:*

- Hamilton Area Transportation Study; the statistics shown include the urbanized area of the Hamilton-Wentworth Region and the City of Burlington
- Hamilton Transportation Strategy Study; the statistics shown include the total Hamilton-Wentworth Region and the City of Burlington
- Regional Planning Department, Hamilton-Wentworth Region; same study area as given under H.T.S.S.

central area of Hamilton is expected. The estimated employment in the core area is projected to expand from 20,000 in 1971 to 32,000 by 1986. Beyond 1986 to 2001, a further increase to 53,000 jobs has been assumed under the TRENDS and HAMILTON CENTRED options while the WESTERN DEVELOPMENT alternative assumes no increase beyond the 1986 level.

### 3.2 DEVELOPMENT STRATEGIES

The Regional Planning Department has indicated how the growth in Hamilton-Wentworth might be distributed if existing developing commitments and policies were to continue, i.e., a TRENDS plan. Through public consideration and discussion of this TRENDS plan, the Planning Department will then prepare a number of "goals plans." Since these alternative development plans were not available at the time of the rapid transit analysis, two development alternatives were selected from the Hamilton Transportation Strategy Study which, along with the TRENDS plan, would broadly cover the range of possible growth options for Hamilton. The two alternatives selected from the Strategy Study are called the "HAMILTON CENTRED PLAN," which assumes that a good portion of the growth would be within the existing City boundaries, and a "WESTERN PLAN," which assumes significant growth of both population and employment in the Flamborough area.

The three development alternatives have common features because the location of a large portion of future growth is committed based on current servicing capacities and programmes, and permitted zoning. The growth in the period 1971 - 1986 of 81,000 persons is committed regardless

of which long-term development pattern is selected. Some 43,000 of the 114,000 population growth expected in the period 1986 - 2001 is common to the three development alternatives. The remaining amount of 71,000 persons is the "floating" population which varies among the alternatives.

In the TRENDS alternative, this floating population was allocated to Hamilton, Flamborough, Dundas, Ancaster and Stoney Creek, below the Mountain. In this alternative, the new community of Saltfleet would have a population of 20,000 persons by the year 2001.

In the HAMILTON CENTRED PLAN, all of this floating population was allocated to the City of Hamilton and the Saltfleet new community. The City of Hamilton would have a population of 416,000 in this plan compared with 398,000 population in the TRENDS alternative, but still considerably less than the 506,000 population permitted by existing zoning as identified by the Planning Department. In the HAMILTON CENTRED PLAN, the Saltfleet new community would have a population of 50,000 by the year 2001.

In the WESTERN alternative, the floating population was allocated to the Flamborough, Dundas and Ancaster areas, with the majority in Flamborough.



The population and employment allocations for the three development concepts for the year 2001 are summarized in Table 3.2 and illustrated in Exhibits 2 and 3. Table 3.2 also indicates the corresponding allocations for the years 1971 and 1986.

The following is a summary of the significant aspects of the population and employment allocations:

1. The population of the Region of Hamilton-Wentworth is expected to increase by 50 per cent by the end of the century. The location of 80 per cent of the growth is committed through all the alternatives, and 20 per cent varies among the alternatives, being located either in the east (TRENDS), within Hamilton (HAMILTON CENTRED) or in the west (WESTERN). Growth is spread over a number of potential rapid transit corridors, with no particular one being favoured.

2. Approximately 40 per cent of the growth in the Hamilton-Burlington area is expected to occur in Burlington, which will tend to lead to increased congestion in the two corridors connecting Burlington and Hamilton.

3. It is expected that the percentage of study area residents in the labour force who would make work trips will increase from the current level of about 0.36 jobs per person to 0.46 jobs per person. This increase will create an additional load on the transportation network beyond that due to population increase.

4. A dramatic increase in the retail and service sector is projected, a good portion of which will be located in office and commercial complexes in downtown Hamilton and in outlying centres. This trend will lead to a concentration of travel in corridors leading to these centres.

5. The growth in the Bay Front Industrial Area is expected to be minimal. Rather, industrial developments are expected on the Mountain, in Stoney Creek (TRENDS concept), or in Flamborough (WESTERN concept). Development of these industrial parks on the periphery of the urban development offers a good opportunity to use transportation capacity in both directions during the peak hour.

### 3.3 TRAVEL DEMAND ESTIMATES

The Regional Planning Department has developed a method for forecasting travel demand in the Hamilton-Burlington area using information on the future distributions of people and jobs. This method estimates total person trips, but does not differentiate between the automobile and transit modes of travel. To apply this traffic prediction model in the Hamilton Rapid Transit Development Programme, it was necessary to add to the traffic model mathematical equations which estimate the percentage of trips which would use public transit.

Two sets of mathematical relationships were developed for estimating future transit usage. The first set of equations reflects the current transit usage policy in Hamilton today. A second set of relationships corresponds to the travel patterns in Toronto today, and would represent a strong effort by the City to encourage transit usage and discourage car usage in the central area. These alternative transit usage policies were applied to estimate the ridership levels within the alternative corridors depending on whether a surface bus system was maintained or a rapid transit facility was provided.

Table 3.2  
POPULATION AND EMPLOYMENT ESTIMATES

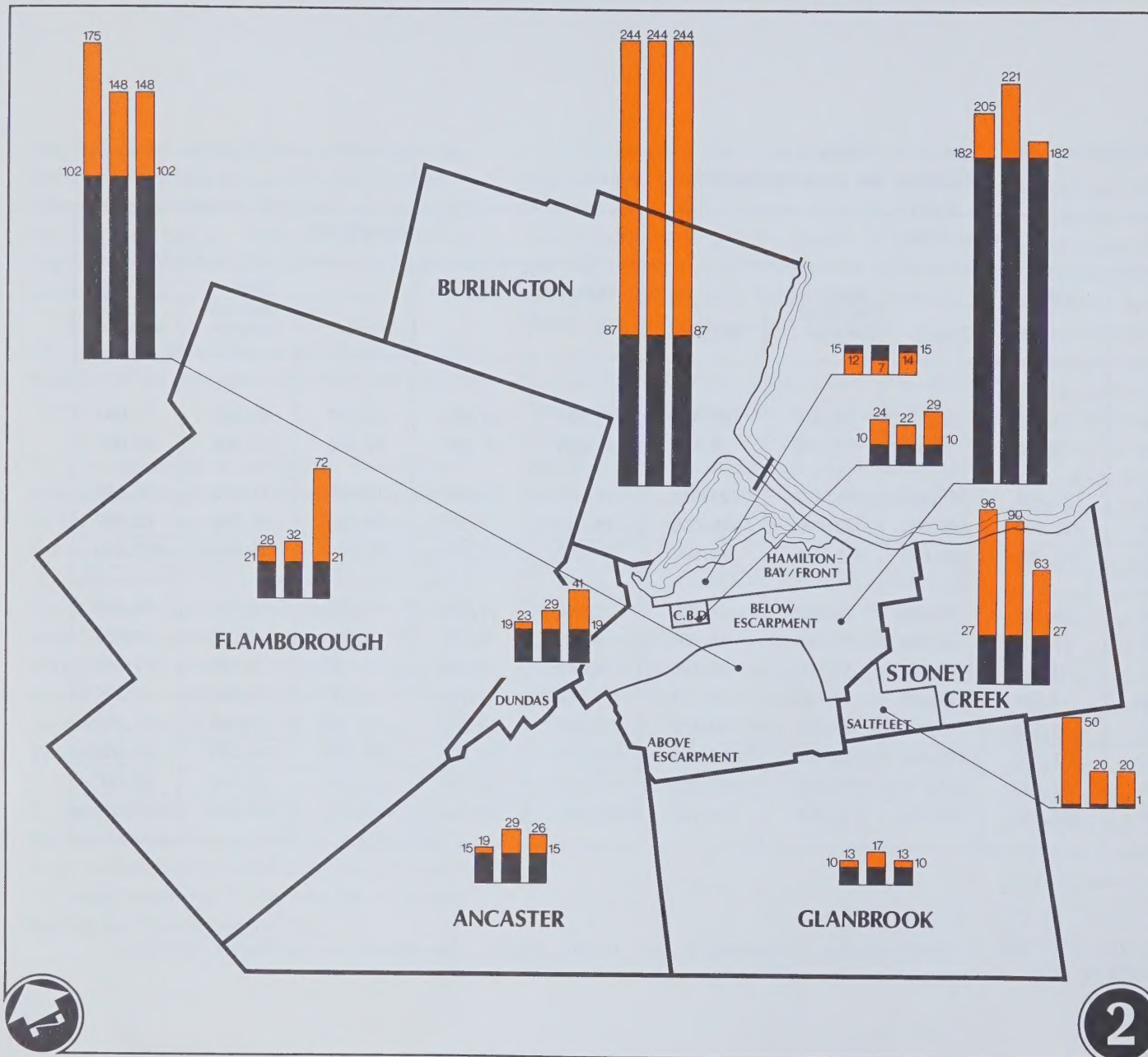
|                         | POPULATION |         |         |                  |         | EMPLOYMENT |         |         |                  |         |
|-------------------------|------------|---------|---------|------------------|---------|------------|---------|---------|------------------|---------|
|                         | 1971       | 1986    | 2001    |                  |         | 1971       | 1986    | 2001    |                  |         |
|                         |            |         | Trends  | Hamilton Centred | Western |            |         | Trends  | Hamilton Centred | Western |
| Hamilton                |            |         |         |                  |         |            |         |         |                  |         |
| - Central Area          | 10,000     | 15,000  | 22,000  | 24,000           | 29,000  | 20,000     | 32,000  | 53,000  | 53,000           | 31,000  |
| - Bay Front             | 15,000     | 8,000   | 7,000   | 12,000           | 14,000  | 45,000     | 50,000  | 51,000  | 56,000           | 53,000  |
| - Rest Below Escarpment | 182,000    | 199,000 | 221,000 | 205,000          | 189,000 | 56,000     | 81,000  | 110,000 | 111,000          | 99,000  |
| - Above Escarpment      | 102,000    | 123,000 | 148,000 | 175,000          | 148,000 | 14,000     | 21,000  | 39,000  | 45,000           | 45,000  |
| Total Hamilton          | 309,000    | 345,000 | 398,000 | 416,000          | 380,000 | 135,000    | 184,000 | 253,000 | 265,000          | 228,000 |
| Flamborough             | 21,000     | 26,000  | 32,000  | 28,000           | 72,000  | 3,000      | 5,000   | 6,000   | 8,000            | 38,000  |
| Dundas                  | 19,000     | 23,000  | 29,000  | 23,000           | 41,000  | 5,000      | 5,000   | 7,000   | 5,000            | 7,000   |
| Ancaster                | 15,000     | 20,000  | 29,000  | 19,000           | 26,000  | 2,000      | 3,000   | 6,000   | 9,000            | 14,000  |
| Glanbrook               | 10,000     | 13,000  | 17,000  | 13,000           | 13,000  | 1,000      | 3,000   | 5,000   | 6,000            | 6,000   |
| Stoney Creek            | 27,000     | 54,000  | 90,000  | 96,000           | 63,000  | 7,000      | 18,000  | 29,000  | 13,000           | 13,000  |
| Region Total            | 401,000    | 481,000 | 595,000 | 595,000          | 595,000 | 153,000    | 218,000 | 306,000 | 306,000          | 306,000 |
| Burlington              | 87,000     | 167,000 | 244,000 | 244,000          | 244,000 | 21,000     | 50,000  | 83,000  | 83,000           | 83,000  |
| Total Study Area        | 488,000    | 648,000 | 839,000 | 839,000          | 839,000 | 174,000    | 268,000 | 389,000 | 389,000          | 389,000 |

Note: Saltfleet community is estimated to have 10,000 population in 1986 and 20,000, 50,000, 20,000, respectively in the TRENDS, HAMILTON CENTRED and WESTERN Concepts by 2001.



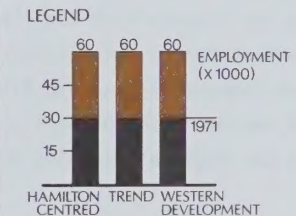
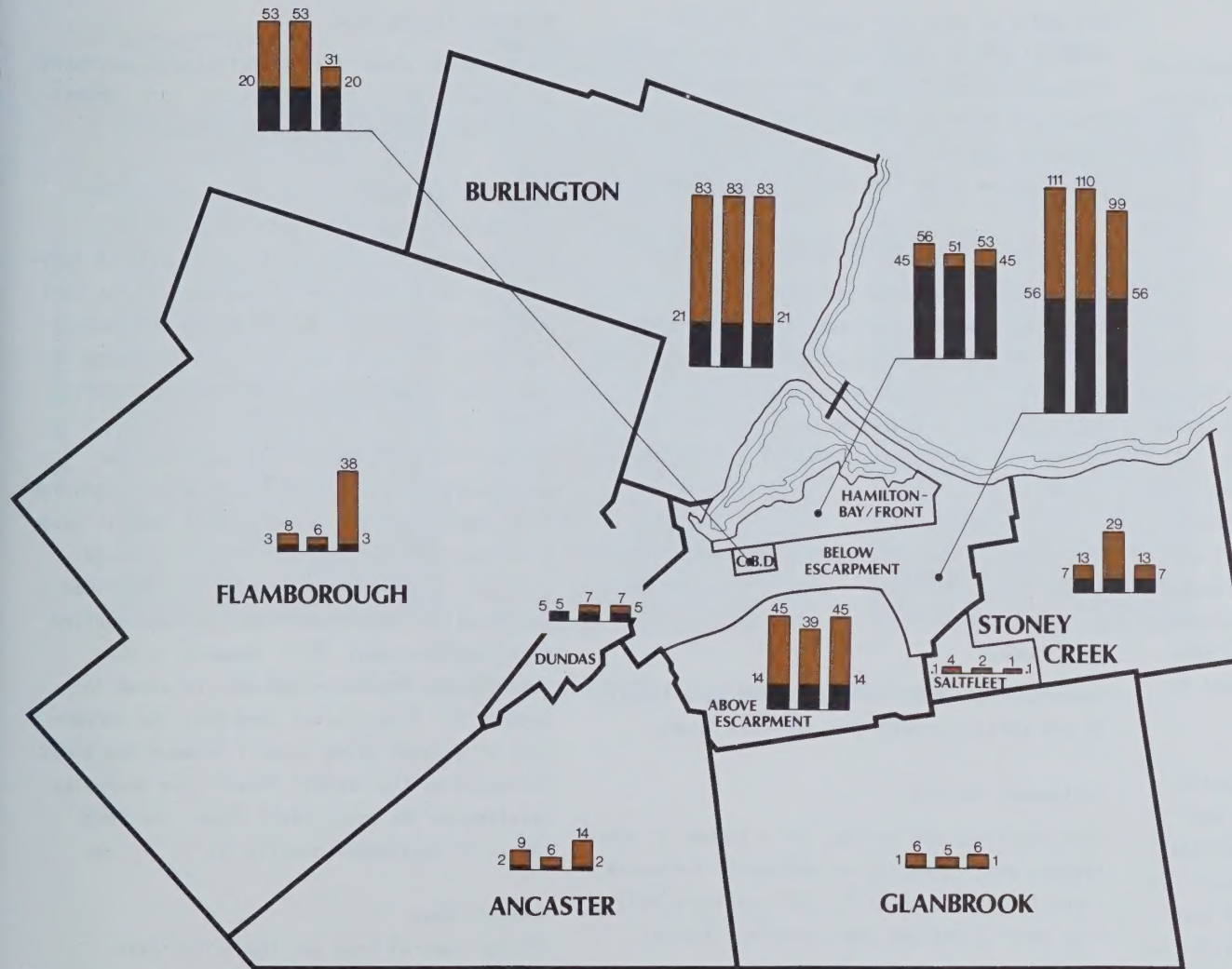
# HAMILTON RAPID TRANSIT DEVELOPMENT PROGRAMME

DE LEUW - DILLON - IBI GROUP



# HAMILTON RAPID TRANSIT DEVELOPMENT PROGRAMME

DE LEUW - DILLON - IBI GROUP



2001  
Development Options

**Employment  
Distribution**



## THE TRAFFIC PREDICTION MODEL

The traffic prediction model used to prepare the travel demand estimates consists of four components:

- trip production
- trip distribution
- modal split
- assignment

The trip production and trip distribution components of the model were developed by the Regional Planning Department and are described in the documentation prepared by the Department. The mathematical relationships incorporated in this model were derived from a number of sources, including the Toronto Area Regional Model Study (TARMS) undertaken by the Ministry of Transportation and Communications, and from a telephone survey of residents in the Hamilton area conducted by the Regional Planning Department in 1974.

The model developed by the Regional Planning Department forecasts trips between home and work and trips between home and other destinations separately. Trips for other purposes are then added as a factor of the home-based work and home-based other trips. Trips generated by special activity areas such as shopping centres

are added to each trip purpose. Finally, external trips, those trips which have one or both ends outside of the Hamilton-Burlington area, are added to obtain total person travel demand in each corridor; these external trips were obtained from the projections by TARMS.

## THE DEVELOPMENT OF MODAL SPLIT RELATIONSHIPS

The process to develop the modal split relationships for Hamilton involved, first, the postulating of factors which affect a person's choice of mode of travel, then deriving values for these factors from various surveys, and finally testing the hypothesis against the observed travel time.

The factors which were considered to affect mode choice are as follows:

### Trip Purpose:

Research shows that work trips are more likely to use public transit than non-work trips.

### Employment Density:

High densities are proxies for a number of other factors which directly or indirectly influence transit usage, such as limited parking supply, high parking charges and convenient transit, coupled with road congestion.

## Relative Travel Time:

Research has shown that transit usage increases as travel time by transit becomes more competitive with travel time by private car.

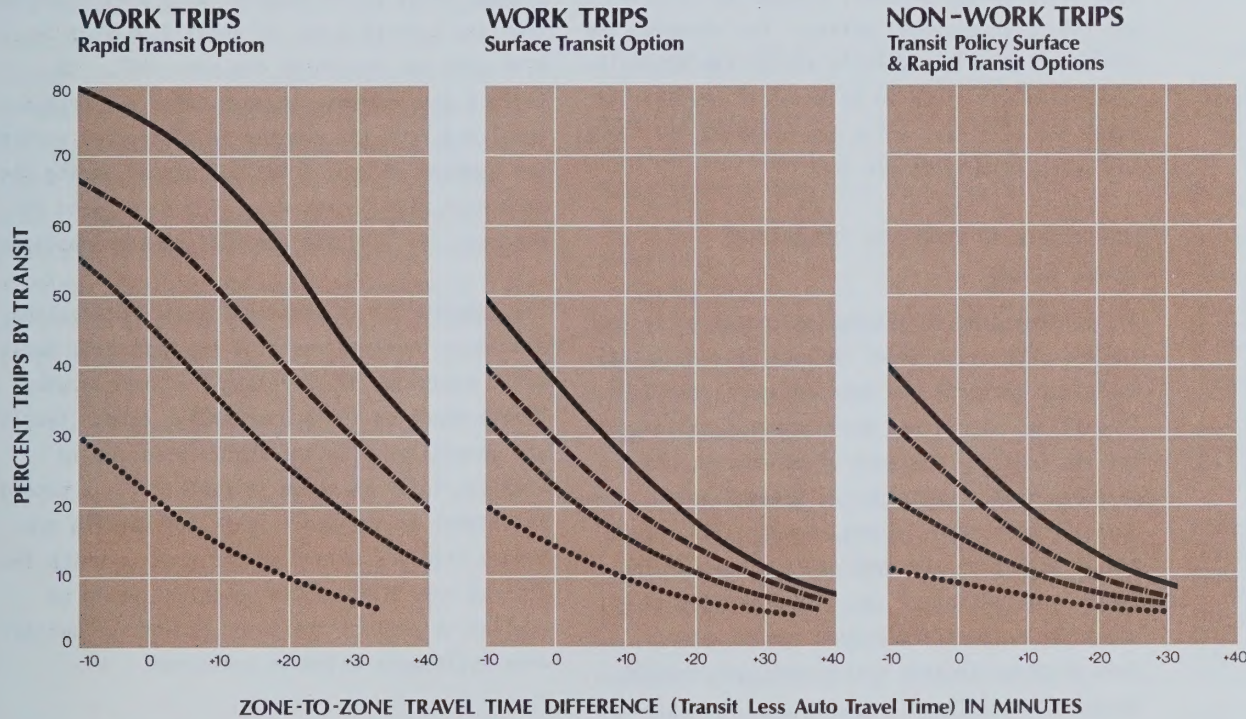
Two other factors, income and car ownership, were not incorporated in the modal split relationships because of the difficulty in forecasting these variables and because it was felt that these variables are not truly independent variables and would tend to overshadow some of the other factors which influence modal split.

For each of two trip purposes and for four employment density levels, mathematical relationships explaining the percentage of transit usage as a function of the travel time difference between transit and auto times were described graphically. These relationships were derived from previous modal split research in the Hamilton and Toronto areas and are shown in Exhibit 4. These curves show that the percentage of persons using transit between two zones increases as the transit travel time decreases relative to the auto travel time. The four levels of employment density are as follows:

- Central Area
- Fringe Central Area and Industrial Area

# HAMILTON RAPID TRANSIT DEVELOPMENT PROGRAMME

DE LEUW-DILLON-IBI GROUP





-Midtown Area

-Suburban Area

Tests were carried out using the relationships shown in Exhibit 4, the land use (population and employment data) and road and transit system characteristics in existence in 1971.

The 1971 population and employment data and the 1971 road system were provided by the Regional Planning Department. A transit system network was developed by the Consultants to represent the bus routes operated by the Hamilton Street Railway, Canada Coach Lines and GO Transit according to the 1971 schedules of these operators. The transit speeds vary from approximately 8 m.p.h. in the central area to 13 m.p.h. in the rest of the urban area, and up to 25 to 40 m.p.h. in the rural areas. One exception to this general rule is the assumption that the bus travel speeds on the non-stop portions of the bus routes, such as up and down the Mountain, were equal to the auto travel speeds.

A comparison of the simulated and observed person trips by mode at selected screenlines throughout the Hamilton-Burlington area indicated that the "current policy" modal split relationships presented in Exhibit 4 are a reasonable mathematical expression of current mode choice behaviour in Hamilton. There are

some differences, however, between the simulated and the observed modal splits. For example, the simulated transit ridership across the Mountain screenline was found to be about 12 per cent of total person trips, while the observed 1971 level was approximately 16 per cent.

#### ADJUSTMENTS TO MODEL FOR FORECASTING TRAVEL DEMAND

The mathematical relationships contained in the traffic prediction model reflect current travel behaviour patterns and socio-economic conditions. Lifestyles, social and environmental values, the availability and cost of resources, and socio-economic conditions in general are changing over time. These changes will affect travel behaviour and need to be accounted for in the application of the travel prediction model for forecasting future travel demand. Some of these factors which were adjusted are discussed as follows:

- work trip rates
- transit usage policies
- auto and bus speeds
- auto occupancies

The Regional Planning Department projects that the jobs per person within the study area

(labour force participation rate) will increase from the current level of about 0.36 jobs to 0.46 jobs per person by the year 2001. To reflect the increase in work trips per person resulting from the greater proportion of workers, the numbers of work trips per person during the peak hour will increase by 15 per cent and 30 per cent for 1986 and the year 2001 respectively.

The adjustments to the modal split forecasting procedure involved revising the work trip modal split equations to represent the transit usage levels observed in Toronto today. These levels are generally twice the levels observed in Hamilton today as shown in Exhibit 4. A second adjustment to the modal split forecasting procedure involved enlarging the area in which the central area modal split equations would be applied to reflect the major growth and central area employment which is projected.

For the preliminary test, the current road and bus travel speeds were maintained. However, in view of the significant road capacity deficiencies in many of the corridors, it was thought to be more realistic to adjust travel speeds to represent the likely 1986 and 2001 levels of congestion. These speed adjustments were incorporated in the final test.

The average number of persons per car during the peak hour in Hamilton is currently 1.4. Larger municipalities, such as Toronto and Ottawa, are observing higher car occupancies. It is expected that, with increasing parking costs, more road congestion and higher fuel costs, the car occupancy in Hamilton will increase to the levels observed in Ottawa and Toronto. We have assumed an increase to 1.5 persons per car by 1986 and the year 2001.

### 3.4 ACTIVITY AREAS

In preparing the travel demand estimates, special attention was given to activity areas which generate unique travel demands, particularly from the standpoint of rapid transit service. These activity areas are as follows:

- hospitals
- shopping plazas
- post-secondary educational institutions
- major industries
- sports facilities
- Hamilton Airport

Information on the traffic-generating characteristics was obtained through interviews and a review of published information. This information included shift times, employment by shift, parking facilities, visitor traffic, special measures of each activity such as number of beds for hospitals and student enrollment for educational facilities.

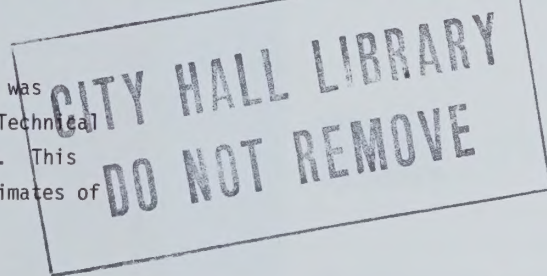
The information on these activity areas was summarized in a paper submitted to the Technical Advisory Committee on November 21, 1975. This information was incorporated in the estimates of future travel demand.

### 3.5 INTER-REGIONAL TRANSIT

A special analysis was also undertaken regarding the routing and patronage on the inter-regional transit services in the Hamilton area. This analysis was based on interviews with the carriers, including Canada Coach Lines and GO Transit.

The information included the peak hour ridership levels for 1971 and estimates of the expected volumes in 25 years. These data were summarized in a paper to the Technical Advisory Committee on November 21, 1975. Again, this information was utilized in preparing the travel demand estimates.

Briefly, the findings indicate the future inter-regional transit would be relatively small compared to the projected transit volumes within the urban area. Consequently, inter-regional transit services should be designed to complement the internal urban transit system.





# 4. Identification of basic rapid transit network

*This section describes the analysis that was carried out to identify the basic rapid transit network for Hamilton by the year 2001.*

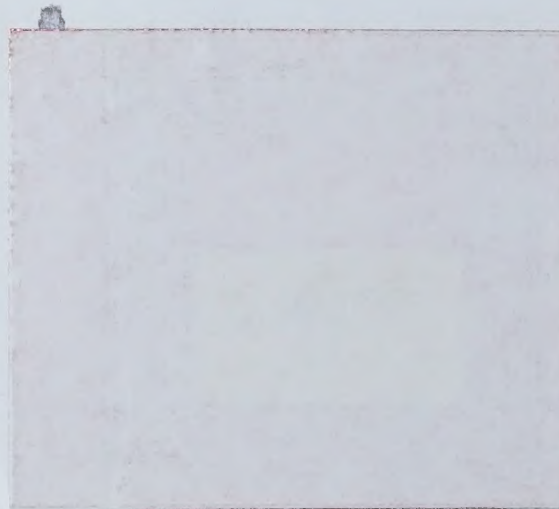
*The analysis involved two steps as follows:*

- 1. A preliminary screening of all the transportation corridors in the area.*
- 2. An examination of the main transit corridors to identify those corridors with potential for rapid transit.*

## 4.1 GENERAL APPROACH

The network analysis was based on year 2001 forecasts to be consistent with the long-term development options being reviewed by the Regional Planning Department.

In carrying out this analysis, the ridership estimates were prepared using a modal split assumption compatible with the provision of rapid transit in the corridor. Corridors with ridership levels in excess of 6,000 passengers per peak hour in the peak direction at the maximum load point were considered to have potential for rapid transit.



## 4.2 PRELIMINARY SCREENING

The first step involved defining a composite rapid transit network that would provide rapid transit service in all major transit corridors. In this process, earlier proposals for rapid transit systems for Hamilton were reviewed together with the results of the Hamilton Transportation Strategy Study. The preliminary test network resulting from this analysis is shown in Exhibit 5. The total length of the network shown is about 50 miles.

For testing purposes, it was assumed that the rapid transit facilities operating in the corridors shown in Exhibit 5 would have an average operating speed of 25 m.p.h., have station locations at about half-mile intervals, and a frequency of 15 trains per hour. There are a number of technologies that would meet these operating standards, including light rail and busways.

Forecasts of transit riders on the preliminary network during the P.M. peak hour on an average weekday in the year 2001 were prepared. The traffic prediction model described earlier in this report was used to prepare these forecasts of transit riders. These forecasts were prepared for each of the three development



# HAMILTON RAPID TRANSIT DEVELOPMENT PROGRAMME

DE LEUW - DILLON - IBI GROUP

1 Mile



GEOGRAPHICAL LIMIT  
OF CORRIDOR

## Preliminary Test Network

5



alternatives, i.e., the TRENDS concept, the WESTERN DEVELOPMENT concept, and the HAMILTON CENTRED concept. In order to investigate thoroughly the potential for rapid transit in Hamilton, the modal split relationships corresponding to the high transit usage policy were employed; however, for comparative purposes, an estimate of rapid transit usage was also prepared using the current transit usage policy.

The main findings of this preliminary screening test were as follows:

- the total travel demand in the area will increase by two to three times by the year 2001, compared to the 1971 level; this increase in trips reflects the 50 per cent growth in population, the 100 per cent growth in employment and the two - threefold increase in employment in the central area;
- if a high transit usage policy is pursued, the percentage of persons travelling by transit during the P.M. peak hour is expected to increase from approximately 11 per cent in 1971 to about 30 to 40 per cent by the year 2001;
- application of the current transit usage policies would result in approximately half the number of transit trips as compared to the high transit usage policies;

- even with a high level of transit usage on the extensive network shown in Exhibit 5, significant deficiencies in road capacity would develop; in order to accommodate on transit the excess road demand, transit usage up to and exceeding 50 per cent of total trips would be required by the year 2001;
- the variation in travel demand among the three development alternatives is generally less than 20 per cent compared to the TRENDS plan; the greatest variation is in the Mountain corridor, it being highest if a HAMILTON CENTRED development policy is pursued.

From the preliminary screening, it was found that relatively high transit volumes could develop in six corridors by the year 2001. These corridors are as follows:

- downtown to the Mountain
- downtown to West Hamilton
- downtown to East Hamilton via the King - Main corridor
- downtown to the Bay Front Industrial Area
- downtown to Burlington via the Highway 403 corridor
- downtown to Burlington via Beach Boulevard

The total length of these six corridors is about 35 miles. These corridors were carried over for

more detailed study in the second step of the analysis as described in the next section.

#### 4.3 TESTING OF NETWORK OPTIONS

Three networks were identified for the second stage of analysis based on different combinations of the six corridors described above. The objective of the second stage was to define a basic rapid transit network for the City. The three networks are as follows:

##### Network A (Exhibit 6):

This network involves a rapid transit line connecting the Mountain with downtown and the industrial area, another line connecting West Hamilton to downtown, and the third line connecting downtown Hamilton to Burlington via the Highway 403 corridor.

##### Network B (Exhibit 7):

This network would provide an east-west rapid transit line across the City in the general vicinity of King and Main Streets. Another line would connect downtown to the Mountain, and a third line would connect downtown Hamilton to Burlington via the Highway 403 corridor.

##### Network C (Exhibit 8):

This network would provide a rapid transit line via the beach strip and the industrial area between Burlington and downtown Hamilton. This

line would continue southward to serve the Mountain residential areas. Another line would connect West Hamilton with downtown.

The three networks are shown in Exhibits 6, 7 and 8. As shown, the downtown-Mountain and the downtown-West Hamilton corridors are common to the three networks. Network A provides direct service to the industrial area, whereas Network B serves East Hamilton via the King-Main corridor. The service to Burlington is located in the Highway 403 corridor in Networks A and B and is located along Beach Boulevard in Network C.

Travel demand forecasts were prepared for the three rapid transit networks and the three urban development concepts for the year 2001. The estimates of the number of riders on each rapid transit line are indicated in Exhibits 6, 7 and 8. These estimates represent the number of riders per peak hour in the peak direction resulting from the provision of rapid transit.

The ranges shown represent the effects of the alternative development concepts on ridership levels.

#### 4.4 SELECTION OF BASIC NETWORK

Exhibit 9 indicates the number of person trips by car at three screenlines in the City for the three 2001 development concepts. Again, these volumes represent the peak direction in the P.M. peak hour. The road deficiencies shown in Exhibit 9 are the differences between the road demands and the existing and proposed road capacities (level of service E) which assume the following road improvements in the current capital works programme:

- widening of York Street
- construction of the Perimeter Road
- extension of Highway 403 from Ancaster to Brantford
- improvement to Burlington Street
- extension of Parkdale Avenue

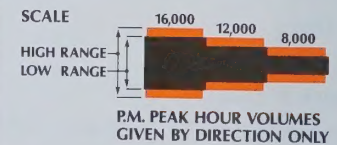
In determining the auto - person capacity, it was assumed that the auto occupancy would be 1.5 persons per car, compared to approximately 1.4 persons today. The estimates shown in Exhibit 9 indicate major road deficiencies in the corridor west of the central area and across the Escarpment, even though 25 to 35 per cent of trips would be made by public transit.



# HAMILTON RAPID TRANSIT DEVELOPMENT PROGRAMME

DE LEUW - DILLON - IBI GROUP

1 Mile



## Alternative Network A

6



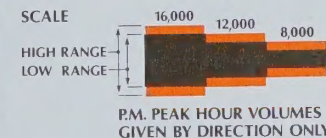
# HAMILTON RAPID TRANSIT DEVELOPMENT PROGRAMME

DE LEUW - DILLON - IBI GROUP

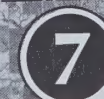
1 Mile



SCALE



## Alternative Network B





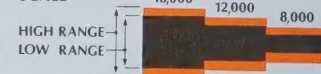
# HAMILTON RAPID TRANSIT DEVELOPMENT PROGRAMME

DE LEUW - DILLON - IBI GROUP

1 Mile



SCALE



P.M. PEAK HOUR VOLUMES  
GIVEN BY DIRECTION ONLY

## Alternative Network C

8



SCREENLINE

①  
②  
③

| 1971        | Hamilton<br>Centred | Trends          | Western<br>Development |                                  |
|-------------|---------------------|-----------------|------------------------|----------------------------------|
| *7,000<br>0 | 18,000<br>2,000     | 20,000<br>4,000 | 19,000<br>3,000        | Road Demand<br>Road Deficiencies |
| 14,000<br>0 | 21,000<br>5,000     | 19,000<br>3,000 | 18,000<br>2,000        | Road Demand<br>Road Deficiencies |
| 9,000<br>0  | 13,000<br>0         | 14,000<br>1,000 | 11,000<br>0            | Road Demand<br>Road Deficiencies |

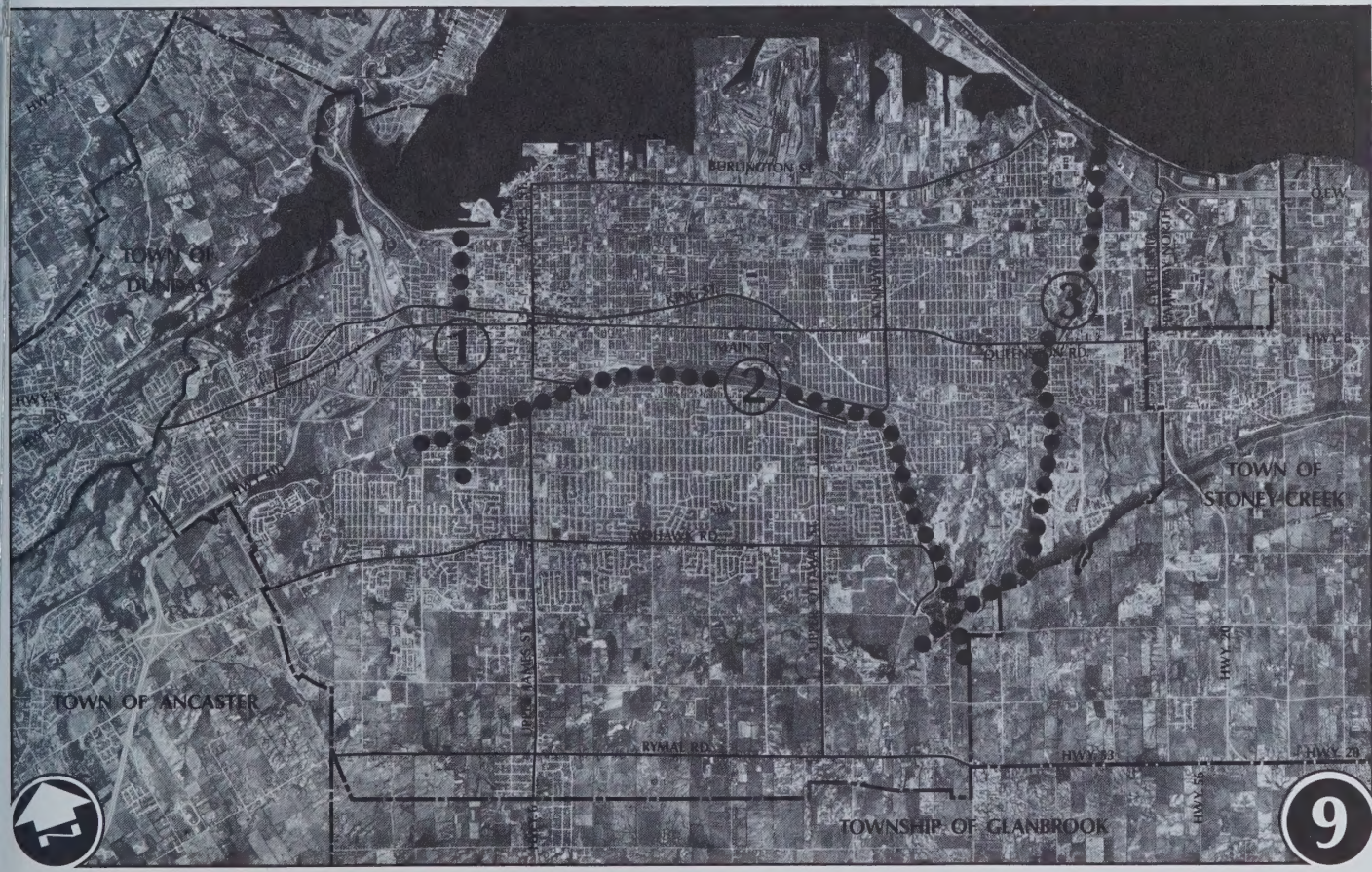
\*Person trips per  
peak hour in the  
peak direction

# HAMILTON RAPID TRANSIT DEVELOPMENT PROGRAMME



DE LEUW - DILLON - IBI GROUP

11 Mile



Networks A,B and C  
(2001)

## Road Capacity Deficiencies

9



The network analysis indicated that the highest rapid transit volumes are projected for the James Street corridor, the West Main Street corridor and the Highway 403 corridor. The rapid transit lines in these three corridors were found to be greater than 6,000 passengers per peak hour in the peak direction by the year 2001.

In terms of effectiveness, then, the network analysis indicates that the basic trunk network should consist of three corridors as follows:

- downtown to the Mountain
- downtown to West Hamilton
- Hamilton to Burlington

The Hamilton to Burlington service is outside the scope of this Study. This type of service could have significant implications on the internal rapid transit network in Hamilton and on the future development of the City. A Burlington service, however, could be routed either via Highway 403, via Beach Boulevard or via both routes depending on many factors including inter-regional transportation programmes (e.g., improvements to the Q.E.W.), future development in Burlington, funding policies with respect to inter-regional rapid transit, and future development and transportation plans in the City of Hamilton.

Given these considerations, we defined the basic trunk network for Hamilton to include the West Hamilton corridor and the Mountain corridor.

The basic trunk network is illustrated in Exhibit 10. The rapid transit volumes in these two corridors could exceed the threshold of 6,000 passengers per peak hour in the peak direction by the year 2001.

Significant road capacity deficiencies are also indicated in these two corridors even with the introduction of rapid transit. Although there is some variation in ridership levels because of the differences in the population and employment allocations for the three land use alternatives considered in the work, these variations are not critical from the standpoint of the basic trunk network. The assignments undertaken in the second stage of analysis indicate that the network would be effective under the three land use alternatives.



# 5. Effect of basic network on travel demands

*The actual travel demands that materialize in Hamilton in the future will be dependent upon the types of transportation facilities that are provided. Transit ridership will be higher if rapid transit is provided than it will be if rapid transit is not developed. Similarly, the construction of major new roads and/or the maintenance of low parking charges will facilitate travel by automobile and will reduce the potential market for rapid transit.*

*This section describes the travel demand estimates that are associated with the basic rapid transit network, as compared to a "no-build" condition which assumed that rapid transit would not be developed and the current transit policies would prevail in the future. The effects of these two conditions on road and transit volumes are summarized for use in the selection of the priority corridor. This section concludes with a discussion of other factors that will affect future travel demand characteristics.*

## 5.1 APPROACH

Travel demand forecasts for the West Hamilton and Mountain access corridors were prepared for 1986 and the year 2001 assuming the TRENDS pattern of development.

In view of the major road deficiencies resulting from the earlier forecasts, the high transit usage policy was assumed and the road speeds were adjusted for both auto and bus travel to reflect congestion as the volumes approach or exceed capacity. The travel demand forecasts for the corridors were compared to a "no-build" network which assumed that no separate rapid transit systems would be constructed and that the current transit usage policies would prevail.

## 5.2 TRANSIT DEMANDS

The 1986 and 2001 estimates of transit travel demands in the Mountain and West Hamilton corridors are summarized in Table 5.1. These estimates were used in the selection of the priority corridor. This table shows the transit volumes in each corridor for the "no-build" case, i.e., without rapid transit, and the corresponding case with rapid transit in each corridor. The table shows that the rapid transit ridership in the West Hamilton corridor would be in the order of 3,000 to 5,500 riders per peak hour in the peak direction in 1986, rising to about 5,500 to 10,000 passengers by the year 2001.

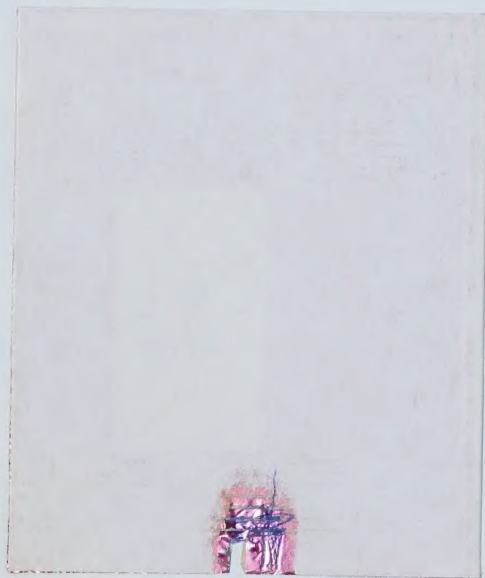
These ranges reflect the impact of alternative policies with respect to service to Burlington via the West Hamilton corridor. The low end of the ranges represents a local transit service to Burlington with significant road congestion on both the Highway 403 and Skyway corridors. The high end of the ranges represents a rapid transit service to Burlington concentrated in the Highway 403 corridor.

The estimates of rapid transit ridership in the Mountain access corridor are 6,000 passengers per peak hour in the peak direction in 1986, rising to about 7,000 to 10,000 riders by the year 2001. The low end of the range represents



a continuation of low density development, while the high end of the range reflects the ridership attained if a high density corridor development were allowed.

As indicated in Table 5.1, the introduction of rapid transit in each corridor will result in higher transit volumes than the "no-build" case.



### 5.3 ROAD REQUIREMENTS

Table 5.2 summarizes the 1986 and 2001 estimates of automobile travel demands in the two corridors of the basic network. This table shows that congestion will develop in both the West Hamilton and Mountain corridors before 1986 if expanded road or transit facilities are not provided. This congestion will continue to increase to the year 2001 and beyond.

A comparison of the "no-build" and rapid transit cases in the Mountain access corridor indicates that rapid transit could reduce the volume of automobile traffic by about 1,500 to 3,500 vehicles by the year 2001. A similar decrease is indicated in the West Hamilton corridor.

Again, the range of volumes of road demand shown in the West Hamilton corridor are dependent on the amount and location of road capacity that is provided between Hamilton and Burlington. The low end of the range represents a case in which the Skyway is widened to eight lanes and traffic is diverted from the Highway 403 corridor. The high end of the range for the West Hamilton corridor represents a case in which there is no increase in capacity in the Highway 403 and Skyway corridors.

### 5.4 DISCUSSION OF PROJECTED TRANSIT USAGE LEVELS

Today, approximately 11 per cent of all daily person trips are made by public transit in Hamilton. If current transit policies prevail, this may increase to approximately 15 to 20 per cent by the end of the century, the increases being due to improvements in the transit system relative to the auto mode, but without the imposition of major parking constraints. The forecasts indicate that, if road and parking strategies which reinforce a policy to encourage greater use of public transit are implemented in Hamilton, the transit ridership might represent 25 to 30 per cent of the total daily trips.

Restricted road construction and parking supply policies have increased transit usage in both Toronto and Ottawa. In terms of trips to and from the central area, the provision of rapid transit together with implementation of appropriate road and parking policies could result in 50 per cent of person trips originating in the core area being made by transit in the P.M. peak hour. The current level being achieved in Hamilton is 37 per cent.

In terms of the transit usage by purpose, the projections indicate that approximately 30 per



Table 5.1  
TRANSIT ESTIMATES FOR BASIC NETWORK  
NUMBER OF RIDERS PER PEAK HOUR IN THE PEAK DIRECTION

| YEAR                              | WEST HAMILTON CORRIDOR                        |                       | MOUNTAIN CORRIDOR                             |                       |
|-----------------------------------|-----------------------------------------------|-----------------------|-----------------------------------------------|-----------------------|
|                                   | "No-Build" Case<br>(without Rapid<br>Transit) | With<br>Rapid Transit | "No-Build" Case<br>(without Rapid<br>Transit) | With<br>Rapid Transit |
| Present Bus and<br>Trolley System | 2,000                                         | -                     | 3,500                                         | -                     |
| 1986<br>Surface System            | 2,500 - 3,000                                 | 500                   | 4,500 - 5,000                                 | 500                   |
| Rapid Transit<br>System           | -                                             | 3,000 - 5,500         | -                                             | 5,500 - 6,000         |
| TOTAL                             | 2,500 - 3,000                                 | 3,500 - 6,000         | 4,500 - 5,000                                 | 6,000 - 6,500         |
| 2001<br>Surface System            | 3,500 - 4,500                                 | 1,000                 | 5,500 - 6,500                                 | 1,000                 |
| Rapid Transit<br>System           | -                                             | 4,500 - 9,000         | -                                             | 7,000 -10,000         |
| TOTAL                             | 3,500 - 4,500                                 | 5,500 -10,000         | 5,500 - 6,500                                 | 8,000 -11,000         |

Table 5.2  
ESTIMATES OF ROAD REQUIREMENTS  
PEAK HOUR - PEAK DIRECTION

| YEAR                         | WEST HAMILTON CORRIDOR                        |                       | MOUNTAIN CORRIDOR                             |                       |
|------------------------------|-----------------------------------------------|-----------------------|-----------------------------------------------|-----------------------|
|                              | "No-Build" Case<br>(without Rapid<br>Transit) | With<br>Rapid Transit | "No-Build" Case<br>(without Rapid<br>Transit) | With<br>Rapid Transit |
| Present                      |                                               |                       |                                               |                       |
| Traffic Demand               | 6,500                                         | Not<br>Applicable     | 8,500                                         | Not<br>Applicable     |
| Road Capacity                | 6,000                                         |                       | 9,000                                         |                       |
| Additional Lanes<br>Required | 1                                             |                       | 0                                             |                       |
| 1986                         |                                               |                       |                                               |                       |
| Traffic Demand               | 9,500                                         | 8,000 - 9,500         | 9,500 -10,000                                 | 9,000 -10,000         |
| Road Capacity                | 9,000*                                        | 9,000*                | 9,000                                         | 9,000                 |
| Additional Lanes<br>Required | 1                                             | 0 - 1                 | 1 - 2                                         | 0 - 1                 |
| 2001                         |                                               |                       |                                               |                       |
| Traffic Demand               | 11,000 -13,500                                | 8,000 -12,000         | 12,500                                        | 9,000 -11,000         |
| Road Capacity                | 9,000                                         | 9,000                 | 9,000                                         | 9,000                 |
| Additional Lanes<br>Required | 3 - 6                                         | 0 - 4                 | 4 - 5                                         | 0 - 3                 |

*\*Assumes construction of the Perimeter Industrial Road and the widening of York Street*



cent of work trips and 10 per cent of non-work trips in the P.M. peak hour will be made by public transit by 2001. The estimated proportion of work trips travelling by transit in Hamilton in 2001 compares with the levels in Ottawa and Toronto today, while the proportion of non-work trips is estimated to be somewhat lower. It is possible that the percentage of non-work trips travelling by transit might be as high as 20 per cent based on Toronto experience. If this level were achieved, the Hamilton rapid transit volumes might be 10 per cent higher than presented earlier in this section of the report.

The following is a discussion of some of the other factors which may encourage higher transit usage, and some which may reduce transit usage.

#### INCREASED ROAD CONGESTION

In the short term, permitting road congestion to increase can mean a spreading of the peak period, a reduction in the discretionary "non-work" trip rates and, particularly, a shift to rapid transit. In the longer term, the presence of significant road congestion can materially retard development, i.e., development will locate in areas of less congestion. The implications of increased road congestion are included in the estimates shown in Tables 5.1 and 5.2.

#### INDUCED DEVELOPMENT

A higher density of development in the Mountain corridor was postulated in order to assess the impact on the rapid transit volume projections. Using densities of 50 persons per acre in the Mountain corridor south of Mohawk Road, some 60,000 additional persons could be accommodated in this area compared to the 25 persons per acre densities implicit in the TRENDS development. Further, a higher level of transit usage for non-work trips to and from the central area was assumed. The net effect of the higher densities and the higher transit usage policies would be a 25 to 35 per cent increase in the rapid transit volumes. This effect is reflected by the upper range of the rapid transit estimates for the Mountain access corridor.

#### MODIFIED WORK WEEK

The population and employment projections prepared by the Regional Planning Department imply an increase in the number of jobs per person from .36 in 1971 to approximately .46 in the year 2001. The final estimates assume that the work trip rates per person in the peak hour would increase by the same proportion.

It is quite conceivable that the increase in jobs per person might be accompanied by shorter

work weeks and a tendency for two or three persons to fill one position at different times of the week, similar to the shift work arrangements in operation at many large industrial plants today. The movement to greater shift operations and shorter work weeks would result in a lower growth in work trips per person, or even a decline in work trips per person during the peak hour. The Hamilton Transportation Strategy Study suggests that a reduction of up to one-third might result, which would tend to negate the peak hour effects of the larger labour force participation rates assumed for 1986 and 2001. Peak hour travel demands might therefore be up to 20 per cent less than those presented in Tables 5.1 and 5.2 but the 24-hour travel demand would not be affected; the resulting levelling of daily peaks would produce a more favourable transit revenue/cost ratio.

#### STAGGERED WORKING HOURS

The Hamilton Transportation Strategy Study examined the effects of staggered work hour schemes and concluded that reductions in peak travel of up to 15 per cent might be achieved. This would mean less peak capacity would be required, a better level of service would be achieved in the peak, and the duration of the peaks would be extended, implying a better

utilization of available capacity during the "shoulder" period and a more favourable transit revenue/cost ratio.

#### SHIFTING OF NON-WORK TRAFFIC

It is estimated that some 33 per cent of the P.M. peak hour travel is non-work travel. These are school, social and recreation, shopping, business and other trips, some of which are discretionary in nature and might be induced to travel at other times of the day by appropriate policy mechanisms. An example is higher parking charges for persons travelling during the peak period, an experiment which is being tried in Toronto at present. The Hamilton Transportation Strategy Study suggests one-quarter of the non-work traffic might be diverted from peak periods, implying a reduction of, say, 8 to 10 per cent of the total peak demand.

#### PRICING POLICIES AND LEVELS OF SERVICE

It is possible that more stringent parking charges and less parking space provision in the central area similar to the Toronto situation might result in the high transit usage projections presented in this report. An analysis of the transit usage that might be achieved if the current transit policy was continued indicated that the transit volumes

would be half of those obtained in the high usage policy.

In terms of the effects of reduced transit fares on transit usage, the Hamilton Transportation Strategy Study pointed out that only a 5 to 15 per cent increase in transit ridership would be expected as a result of a major reduction in transit fares. The Hamilton Transportation Strategy Study went on to say that significant improvements in the convenience of public transit can result in major increases in transit usage. These effects are in large part incorporated in the high transit usage modal split equations which were used to develop the travel demand forecasts.

#### CAR OCCUPANCY AND VEHICLE SIZE

An increase in the number of occupants per automobile would tend to increase the person capacity of the road system. A number of experiments in car pooling have been tried, but without success. The Hamilton Transportation Strategy Study points out that the reduction in car size would not have a significant effect on road capacity.

It is possible that the recent increase in the cost of energy may result in a greater tendency

to car pooling and the use of small vehicles. The implications of the car occupancy increasing from 1.4 to 1.5 persons per automobile are reflected in the final estimates. If this were to increase to 2.0 persons per automobile in the peak period, the person-carrying capacity of the road network would be increased in the peak by approximately 33 per cent. In some corridors, this is the level of the excess auto demand, implying that this level of car occupancy will need to be achieved or the excess will need to shift to the rapid transit system.



## 5.5 SUMMARY

In summary, the following factors suggest that future peak period transit usage might be higher than the final estimates:

- increased cost of energy
- increased auto congestion (already incorporated in forecasts for alternative priority corridors)
- induced urban development
- restrictions on road construction specifically focused on the central area

The following factors suggest that future peak period transit usage might be lower than the final estimates:

- a shorter work week
- staggered hours
- shift non-work trips to the off-peak period
- a reluctance to institute the high transit usage policy

The first three of the above factors would tend to spread transit usage more evenly rather than reducing 24-hour transit usage substantially, thus favouring more cost-effective transit operations.

The overriding factor influencing peak period transit usage would be a transportation policy

in Hamilton which would restrict the amount of road construction in the corridors comprising the Basic Trunk Network, limit the amount of core area parking available to employees, and place a premium on the use of the parking spaces provided. This being the case, the transit usage projections shown in Table 5.1 are considered reasonable.

# 6. Priority corridor selection

*This section of the report outlines a description of the two corridor options, the evaluation method and the analysis used to identify the priority transit corridor for inclusion in the Hamilton Official Plan.*

As described in Section 3, the Basic Rapid Transit Network is made up of two corridors: one between the downtown area and the Mountain, and the other between the central area and West Hamilton. Their location is illustrated in Exhibit 10.

## MOUNTAIN CORRIDOR

This corridor is divided into two sections by the Escarpment. Above the Escarpment, the corridor is bounded by West Fifth Street on the west and by Upper Wentworth on the east. Below the Escarpment the corridor is bounded by MacNab Street on the west and Ferguson Avenue on the east.

## WEST HAMILTON CORRIDOR

This corridor is bounded by the T.H. & B. Railway on the south and by a northerly limit formed by the interconnection of Cannon Street-York Street and King Street west of Highway 403.

The analysis as described in this section resulted in the selection of the Mountain corridor as the priority area for the initial development of a rapid transit network in Hamilton. The remainder of this section details the evaluation and outlines the comparison of the two corridors.

## 6.1 EVALUATION METHOD

The network analysis dealt with broad issues based on the estimated requirements for the year 2001. The priority corridor evaluation deals with more specific impacts using 1986 information as the short-term horizon. The evaluation includes an analysis of the impact of introducing a rapid transit right-of-way within the corridor both in terms of effect on the total transportation system within the corridor and the community impact in terms of potential disruption and costs.

The evaluation factors listed provide a comparative basis for making a selection between the corridor alternatives. In addition, the information adequately details the implications of a rapid transit alternative in satisfying the transportation demand within these two corridors.

In order to develop a reasonable measure of each of the evaluation factors, a representative alignment was selected within each corridor. The major consideration in developing these representative alignments was to ensure the functional and physical feasibility of providing a rapid transit system and to confirm the consistency of the assumptions in each

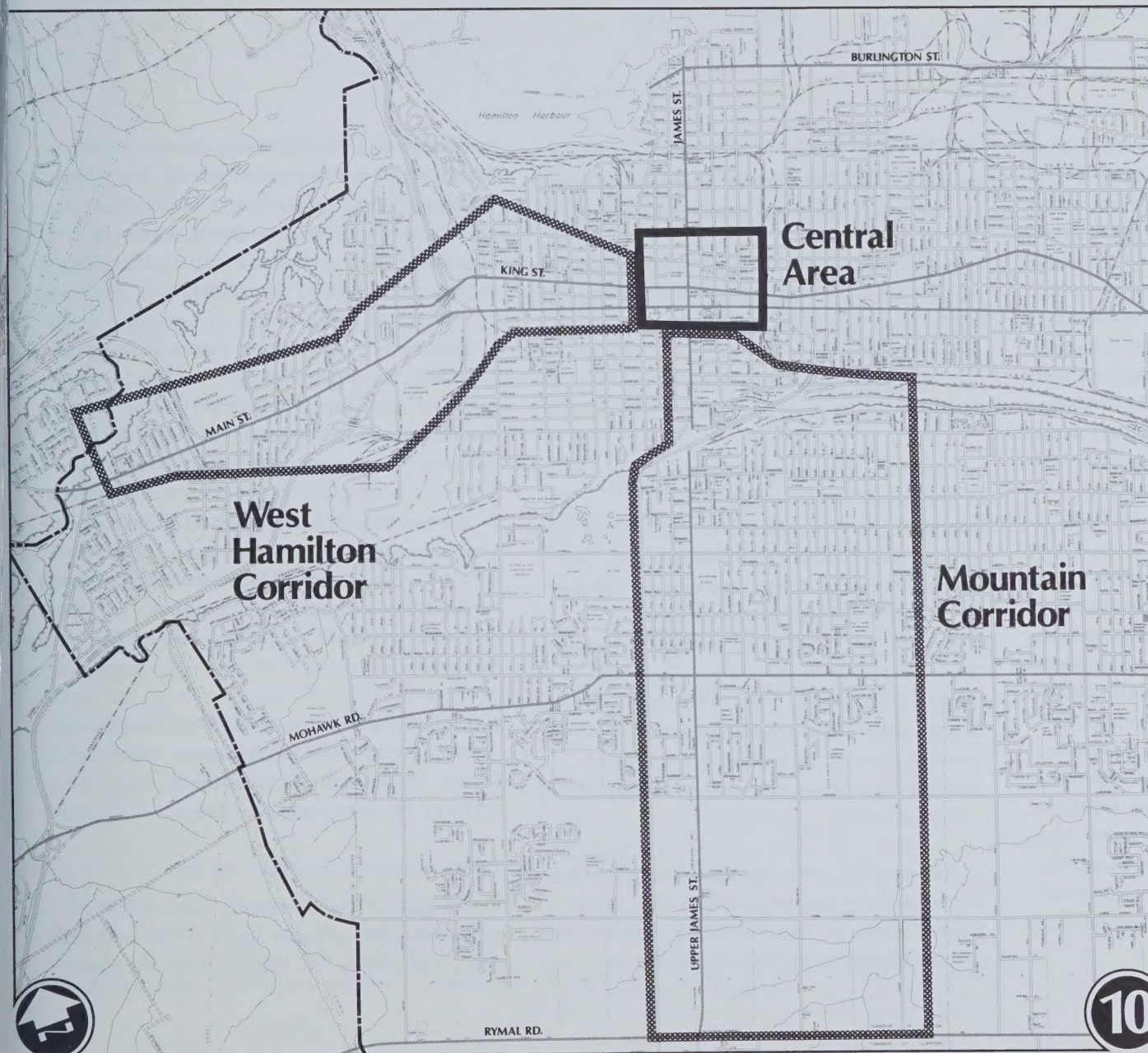




# HAMILTON RAPID TRANSIT DEVELOPMENT PROGRAMME

DE LEUW - DILLON - IBI GROUP

1 Mile



## Recommended Basic Trunk Network



corridor relative to the other to provide a valid comparison. Care was taken to make certain the assumptions in each corridor were consistent with respect to the projected demands and type of facility.

We recognize that further detailed alignment studies may indicate a more desirable alignment is available within each corridor or that there may exist an alternative which would further reduce capital costs. However, as the intent of this analysis is to determine the priority corridor, the selection of representative alignments is considered valid.

Similar to the rationale for the designation of typical facility alignments, representative system technologies were selected to develop the capital costs of construction. The selection of a technology for this analysis should not be misunderstood as a predetermination of the vehicle type to be used in Hamilton. We suggest the selection of the vehicle type be undertaken after the decision to implement rapid transit in Hamilton has been made. In this way, the municipality can take advantage of the vehicle system technology improvements made during the interim period.

#### EVALUATION FACTORS

Six factors were identified to provide a basis for the selection of the priority corridor.

1. Transit Usage - this factor is comprised of the following sub-components:

- the present peak hour ridership in the peak direction;
- the 1986 peak hour volume; and
- the 2001 peak hour transit demand.

2. Impact on Transportation System - this factor is made up of two sub-factors:

- the effect on the road system measured in terms of the lane deficiency in the corridor. The feasibility of providing the roadway and the estimated costs were also determined;
- the relief provided to the surface bus system in each corridor by providing a separate right-of-way system. The reduction in the annual operating costs compared to providing similar capacity by expanding the present transit service was used as the measure of the relief provided.

3. Compatibility with Development Goals - the degree to which the introduction of a rapid transit system will be consistent with the land use development objectives within the corridor

is described. The assessment focuses on the potential to reinforce the land use goals by virtue of providing a separate right-of-way transit system. The development proposals were identified in conjunction with the City and Regional Planning Departments.

4. Staging Potential - this factor includes the consideration of physical feasibility of construction staging and the potential to stage the introduction of a policy of surface transit priority measures within each corridor.

5. Environmental/Community Impact - the comparative potential disruption of the public, not only in terms of the dislocation due to property purchase but also the long-term effect on those residents who would remain adjacent to the facility.

6. Capital Costs - the cost of construction, including potential property costs determined by the City Real Estate Department, are detailed for each corridor option.

#### REPRESENTATIVE ALIGNMENTS

Within each of the corridors, representative alignments were selected based on the estimated ridership demand, the topographical features



within the corridor, the present development and typical geometric limitations of the available technologies. In this way a more definitive appraisal of the effects under each of the listed factors could be made. In the Mountain corridor, the 1986 demand forecasts indicate a cumulative volume range of 5,500 to 6,000 passengers per hour in the peak direction at the brow of the Escarpment. South of Mohawk Road, the ridership drops below 3,000 passengers per hour in the peak direction. In this volume range, transit service is generally more cost-effectively provided by a conventional surface transit operation. As a result, the southerly limit of the separate right-of-way system was assumed to be Mohawk Road.

The Escarpment creates a difference in elevation of approximately 300 feet between the areas above and below it. This elevation difference, combined with the limiting grades of the present transit technologies, will require a completely grade-separated facility between Fennell Avenue and the downtown core area.

In the West Hamilton corridor, the anticipated 1986 demand falls below 3,000 passengers per hour in the peak direction in the vicinity of Main Street and Paradise Road. Similar to the rationalization given under the North - South

corridor, the westerly limit of the separate right-of-way system was assumed in the vicinity of Paradise Road.

As the development within this corridor is relatively mature, the potential for using public open space or other transportation rights-of-way is limited. The likely need to grade separate this facility between the central area and Dundurn Street has been reflected in the assumed alignment.

The attitude assumptions, i.e., at-grade, underground or elevated, related to each corridor are summarized in the following table:

| REPRESENTATIVE ALIGNMENTS<br>SUMMARY OF ATTITUDE ASSUMPTIONS |                                                        |                                                               |
|--------------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------------|
| Attitude                                                     | Mountain Corridor<br>Central Area<br>to Mohawk<br>Road | West Hamilton<br>Corridor Central<br>Area to Paradise<br>Road |
| Tunnel                                                       | 0.85 miles                                             | - miles                                                       |
| Retained Cut                                                 | 0.25                                                   | 0.75                                                          |
| Cut and Cover                                                | 0.20                                                   | 0.60                                                          |
| At-Grade                                                     | 0.70                                                   | 0.10                                                          |
| Elevated                                                     | 0.20                                                   | 0.20                                                          |
| Total Length                                                 | 2.20 miles                                             | 1.65 miles                                                    |

As each of the corridors is focused on the central area of the City, this zone is a common element in both alternatives. As a result, the central area has been treated separately and does not enter into the selection process. However, consideration of this area is required to provide a complete picture of the implications of introducing a separate right-of-way transit operation. Under the analysis, this area is bounded by Bay Street, Cannon Street, Ferguson Avenue and the T.H. & B. Railway right-of-way.

The desirable and ultimate type of facility in this area is a completely grade-separated facility to provide the capacity required to handle the anticipated passenger volumes. This concept should be incorporated into the future redevelopment of the central area.

As an interim solution, recognizing the cost of providing a grade-separated facility in the short-term, an at-grade option which could handle the passenger volume during the next 15 years should be considered. The feasibility of this interim proposal should be confirmed considering the implications for the transit operation, traffic circulation and private access.

## REPRESENTATIVE TECHNOLOGIES

A broad performance specification for the type of technology suitable for Hamilton is given in Section 7 of this report. The performance specification focuses on:

- the system capacity requirements;
- the performance standards related to grade and curvature requirements; and
- the flexibility of operating at different attitudes and of allowing the staged expansion of the system.

Of the present systems available, the conventional diesel bus and light rail vehicle appear to best satisfy the broad performance specifications. Both these technologies are in revenue service with a proven reliability and well documented unit capital and operating costs in other centres.

For corridor evaluation purposes, we have based the costing on a diesel bus technology. The capital cost implications under a light rail technology are given. Further information on the operating costs and performance characteristics of these two systems are given in Section 7.

## 6.2 CORRIDOR EVALUATION

After confirming the procedure of selecting representative alignments and transit technologies with the Technical Advisory Committee, the evaluation of the alternative corridors was prepared under the six criteria. The information is summarized in Table 6.1 and is expanded upon in the remainder of this section.

### TRANSIT USAGE ✓

The total travel demand and estimated transit ridership is outlined in Table 6.2. The projected transit demands in the two corridors are in approximately the same range but the Mountain estimates are generally higher than those for the West Hamilton corridor.

The demand level projected in the East - West corridor assumes the provision of high quality transit service between Burlington and Hamilton focused on the Highway 403 alignment. At present, the decision to orient transit services in the Highway 403 corridor has not been established due to the possible expansion of road facilities in the Skyway corridor which may include provision for priority transit operation. Future growth in Burlington is also uncertain and is outside the control of the Region of Hamilton-Wentworth.

This degree of uncertainty does not apply to the North - South corridor demand estimates. The present demand in this corridor is well established. The projected ridership is considered realistic and possibly conservative in view of the potential to increase ridership by intensifying the residential and commercial development in this corridor.

In summary, with respect to present and potential transit usage, the North - South corridor is considered to be of higher priority than the East - West corridor, principally because the ridership forecasts are not dependent on other major transportation decisions and external development decisions.

### IMPACT ON TRANSPORTATION SYSTEM ✓

This criteria is intended to point out any advantages seen in the provision of rapid transit in each of the corridors with respect to reducing the need for road expansion and the annual transit operating costs. Table 6.2 summarizes the effect of a separate right-of-way transit facility on the corridor lane requirements and the expected reduction in transit operating costs.



Table 6.1  
SUMMARY OF CORRIDOR EVALUATION

| Evaluation Factors                                                   | West Hamilton Corridor                                                      |            | Mountain Corridor                                                                  |            |
|----------------------------------------------------------------------|-----------------------------------------------------------------------------|------------|------------------------------------------------------------------------------------|------------|
| 1. Transit Usage: P.M. Peak Hour - Peak Direction                    |                                                                             |            |                                                                                    |            |
| •1975 Passenger Volume                                               | 2,200                                                                       |            | 3,300                                                                              |            |
| •1986 Passenger Volume                                               | 3,500 - 6,000*                                                              |            | 5,500 - 6,500                                                                      |            |
| •2001 Passenger Volume                                               | 5,500 -10,000*                                                              |            | 8,000 -11,000                                                                      |            |
| 2. Impact on Transportation System                                   |                                                                             |            |                                                                                    |            |
| •Feasibility of Corridor Road Expansion                              | Limited                                                                     |            | Limited                                                                            |            |
| •Estimated Cost of Corridor Road Construction Deferral to 2001       | \$12.5 - \$25.0 M                                                           |            | \$27.0 - \$38.0 M                                                                  |            |
| •Estimated Reduction in 1986 Corridor Annual Transit Operating Costs | \$ 0.3 M                                                                    |            | \$ 0.5 M                                                                           |            |
| 3. Compatibility with Development Goals                              | Not consistent with short-term development goals for present neighbourhoods |            | Reinforces potential for suggested high density North - South corridor development |            |
| 4. Staging Potential                                                 |                                                                             |            |                                                                                    |            |
| •Construction Staging                                                | Limited                                                                     |            | Limited                                                                            |            |
| •Staging of Priority Transit Improvements                            | Limited                                                                     |            | Good                                                                               |            |
| 5. Environmental/Community Impact                                    |                                                                             |            |                                                                                    |            |
| •Short-term Property Disruption                                      | Significant                                                                 |            | Minor                                                                              |            |
| •Long-term Effect on Neighbourhood                                   | Minor                                                                       |            | Minor                                                                              |            |
| 6. Capital Cost (Excluding Vehicles)                                 | Bus Rapid                                                                   | Light Rail | Bus Rapid                                                                          | Light Rail |
| • Construction Cost                                                  | \$44.1 M                                                                    | \$52.1 M   | \$35.6 M                                                                           | \$38.6 M   |
| • Property                                                           | 3.4 M                                                                       | 3.4 M      | 2.2 M                                                                              | 2.2 M      |
| TOTAL                                                                | \$47.5 M                                                                    | \$55.5 M   | \$37.8 M                                                                           | \$40.8 M   |

\*Assumes express commuter services between Burlington and Hamilton

Table 6.2  
PRIORITY CORRIDOR SELECTION  
TOTAL TRAVEL DEMAND, TRANSIT DEMAND AND ROAD DEFICIENCY ESTIMATES

| Year                              | West Hamilton Corridor<br>@ Dundurn Street |                 | Mountain Corridor***<br>@ the Escarpment |                 |
|-----------------------------------|--------------------------------------------|-----------------|------------------------------------------|-----------------|
|                                   | "No-Build"                                 | Rapid Transit   | "No-Build"                               | Rapid Transit   |
| 1975                              |                                            |                 |                                          |                 |
| Auto Person                       | 8,800                                      | -               | 11,900                                   | -               |
| Surface Transit Person Trips      | 2,200                                      | -               | 3,300                                    | -               |
| Rapid Transit Person Trips        | -                                          | -               | -                                        | -               |
| Modal Split to Transit            | 0.20                                       | -               | 0.22                                     | -               |
| Road Capacity @ 750 veh./lane     | 6,000                                      | -               | 9,000                                    | -               |
| Road Demand @ 1.35 persons/veh.   | 6,500                                      | -               | 8,800                                    | -               |
| Road Deficiency (number of lanes) | 1                                          | -               | -                                        | -               |
| 1986                              |                                            |                 |                                          |                 |
| Auto Person Trips                 | 13,800 - 14,300                            | 11,100 - 13,100 | 16,000 - 15,500                          | 14,000 - 14,500 |
| Surface Transit Person Trips      | 2,500 - 3,000                              | 500             | 4,500 - 5,000                            | 500             |
| Rapid Transit Person Trips        | -                                          | 3,000 - 5,500*  | -                                        | 5,500 - 6,000   |
| Modal Split to Transit            | 0.15 - 0.18                                | 0.21 - 0.33     | 0.22 - 0.24                              | 0.29 - 0.32     |
| Road Capacity @ 750 veh./lane     | 9,000**                                    | 9,000           | 9,000                                    | 9,000           |
| Road Demand @ 1.50 persons/veh.   | 9,500                                      | 7,400 - 8,700   | 10,000 - 10,300                          | 9,300 - 9,700   |
| Road Deficiency (number of lanes) | 1                                          | -               | 1 - 2                                    | 0 - 1           |
| 2001                              |                                            |                 |                                          |                 |
| Auto Person Trips                 | 16,500 - 20,000                            | 10,100 - 18,500 | 17,700 - 18,700                          | 13,000 - 16,000 |
| Surface Transit Person Trips      | 3,500 - 4,500                              | 1,000           | 5,500 - 6,500                            | 1,000           |
| Rapid Transit Person Trips        | -                                          | 4,500 - 9,000*  | -                                        | 7,000 - 10,000  |
| Modal Split to Transit            | 0.18                                       | 0.27 - 0.50     | 0.23 - 0.27                              | 0.33 - 0.45     |
| Road Capacity @ 750 veh./lane     | 9,000                                      | 9,000           | 9,000                                    | 9,000           |
| Road Demand @ 1.50 persons/veh.   | 11,000 - 13,500                            | 7,000 - 12,000  | 12,000 - 12,500                          | 9,000 - 11,000  |
| Road Deficiency (number of lanes) | 3 - 6                                      | 0 - 4           | 4 - 5                                    | 0 - 3           |

\*Assumes express commuter services between Hamilton - Burlington in Highway 403 corridor

\*\*Assumes construction of Perimeter Industrial Road and the widening of York Street

\*\*\*Assumes completion of the Parkdale Avenue Extension by 1986



*Mountain Corridor - Impact on Road Requirements*

Under road facility requirement, rapid transit could eliminate the need to provide an additional lane of capacity by 1986 and a minimum of two additional lanes by the year 2001.

Discussions with the City Traffic Department and the Regional Engineering Department indicate there may be potential to expand the capacity of the road facilities by approximately 4,300 vehicles per hour in the peak direction. The assumed road improvements include:

| Facility                 | Section                                                                                                                                                                                                                                                   | Added Vehicle Capacity | Estimated Improvement Cost - 1974 |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------------------------------|
| Beckett's Drive          | <ul style="list-style-type: none"><li>- 4-lane section; from Aberdeen to Fennell</li><li>- 6-lane section; Aberdeen to Charlton</li><li>- intersection improvement at Fennell and Mohawk</li></ul>                                                        | 600 vph/pd             | \$ 8.0 M                          |
| Upper James              | <ul style="list-style-type: none"><li>- 6-lane section; from Claremont Access to Rymal Road</li></ul>                                                                                                                                                     | 900 vph/pd             | \$ 7.0 M                          |
| James Street             | <ul style="list-style-type: none"><li>- 1 additional lane added between Forest Avenue and St. Joseph's Drive</li></ul>                                                                                                                                    | 800 vph/pd             | \$ 0.4 M                          |
| Sherman Cut              | <ul style="list-style-type: none"><li>- improvements to Charlton Avenue, Claremont Access Ramps and Wentworth</li><li>- Sanford including grade separation</li></ul>                                                                                      | 700 vph/pd             | \$ 4.0 M                          |
| Kenilworth - Crosthwaite | <ul style="list-style-type: none"><li>- formation of one-way pair from Burlington Street to T.H. &amp; B. including reconstruction of T.H. &amp; B. underpass</li><li>- widen Kenilworth Access to 6 lanes from Sherman Access to Mountain Brow</li></ul> | 1300 vph/pd            | \$27.0 M                          |

The feasibility of some of these projects has yet to be confirmed and may prove impractical. In any event, the figures provide a reasonable indication of the expenditure which would be required to provide the additional road capacity to accommodate the increased travel demand. In addition, these demand requirements are based on the assumption of the completion of the Parkdale Extension which, if not constructed, would increase the need for additional road facilities in the Mountain corridor.

The provision of a separate right-of-way transit corridor could reduce the 2001 road expansion needs by a minimum of two lanes in the peak direction and possibly more if future land use proposals allow intensification of growth adjacent to the facility. Depending on the land use, the provision of rapid transit could defer road expenditures totalling between \$27.0 M and \$38.0 M.

Beyond the year 2001, further road improvements to provide additional capacity across the Escarpment appear impractical. As the 2001 population level projected for the Mountain represents approximately 60 per cent of the ultimate population capacity, future growth in this area beyond 2001 appears likely.

Consequently, the provision of a separate right-of-way transit system offers good potential for reducing the magnitude of the additional roadway requirements in both the short-term and long-term planning periods.

#### *Mountain Corridor - Impact on Surface Transit Operations*

As a measure of the possible benefits to the surface transit operations, an estimate of possible reduction in annual operating costs was estimated for 1986.

The present transit routes were extended to provide coverage to projected areas of development. The annual operating costs based on daily bus-hours and bus-miles were calculated using 1975 unit costs.

To determine the effects of an exclusive right-of-way operation, the representative alignment was superimposed on the 1986 surface transit routes. The routes were then modified to take advantage of the right-of-way while maintaining a comparable level of service to the Mountain residents.

The estimated annual cost reduction is \$500,000 under the rapid transit option. The ability

to maintain higher scheduled operating speeds reduces the vehicle and bus-hour requirements to carry a similar passenger volume with a surface transit system.

#### *West Hamilton Corridor - Impact on Road Requirements*

Similar to the Mountain corridor, the West Hamilton corridor could reduce the need for additional road facilities by one lane in 1986 and by at least two lanes by the year 2001.

The expansion of road facilities in this corridor will be difficult due to the lack of available right-of-way to provide additional lanes. To provide an indication of the cost implications, the following possibilities were identified in conjunction with the City Traffic Department. The widening of King - Main Streets is assumed to be undertaken as additional right-of-way becomes available during future redevelopment.



| Facility                              | Section                                                                                                                     | Added Vehicle Capacity | Estimated Improvement Cost - 1975 |
|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|------------------------|-----------------------------------|
| King Street                           | Bay Street to Dundurn Street                                                                                                | 800                    | \$ 2.0 M                          |
| New Roadway                           | Highway 403 to Bay Street, provide 2-lane facility adjacent to T.H. & B. right-of-way with ramp connections to Highway 403. | 1000                   | \$12.5 M                          |
| King - Main Streets; Main Street West | John Street to Dundurn Street; Highway 102 to Paradise Road                                                                 | 800                    | \$10.5 M                          |

Again, as in the Mountain Corridor, the feasibility of the projects listed has not been confirmed and some of them may prove impractical.

The estimated increase in road capacity would meet the minimum expected traffic requirements by 2001. If expansion of the Skyway corridor is not provided to accommodate a large portion of the Hamilton - Burlington travel, the road projects listed would not be able to carry the anticipated traffic. Further, the road capacity estimates assume the construction of the Perimeter Road by 1986. If not completed, the need for additional transportation facilities

is intensified in this corridor. The provision of separate right-of-way transit could reduce the 2001 road expansion needs by a minimum of two lanes or more depending on the type of transit facilities provided between Hamilton and Burlington. The provision of rapid transit could defer road expenditures totalling between \$12.5 M and \$25.0 M.

The increase in population in the West Hamilton corridor beyond 2001 will be minimal as the population used in the year 2001 represented the estimated residential capacity of the neighbourhoods. The enrollment at McMaster

University is not expected to increase substantially if current trends persist. As a result, the potential of rapid transit to reduce road requirements in the West Hamilton corridor beyond 2001 will depend on the type of transit service provided to the increasing populations in Dundas and Burlington.

#### *West Hamilton Corridor - Impact on Surface Transit Operations*

An analysis of the effect of a separate right-of-way transit facility was carried out similar to the methods used in the Mountain corridor. The estimated reduction in annual H.S.R. operating costs would be \$300,000. This figure does not include any possible reduction in the operating cost of providing a Hamilton - Burlington transit service.

#### COMPATIBILITY WITH DEVELOPMENT GOALS

The evaluation of the two corridors with respect to compatibility with development goals was carried out in conjunction with the City Planning Department.

The evaluation was based on the existing Official Plan and its amendments, the present neighbourhood plans for the lower City, Jackson Square and York Street redevelopment plans, and the recently completed Core Area Study.

The construction of a rapid transit facility can affect future development by increasing the demand for particularly high density facilities near the station nodes. This may result in the creation of a high density strip development with ancillary commercial and institutional facilities.

No official goals or policy directives to establish a high density corridor in any area of the City presently exist. However, on the basis of the urban design study of the central area, members of the Planning staff have suggested the possibility of creating a North-South high density spine connecting the Mountain with the lower city. This concept was presented to the City Planning and Development Committee in an interim report (February 1976).

In evaluating the two options, the Mountain corridor would reinforce the staff development plan by improving the transportation linkage between the downtown core and the development above the Escarpment.

At present, they do not wish to encourage any short-term linear concentration of development in the West Hamilton corridor. The residential neighbourhoods to the west of the central area are included in a neighbourhood improvement

programme. Any proposal to provide a separate right-of-way through the East - West corridor in the immediate future would disrupt the restoration programme underway and thus would not be compatible with the short-term planning for this residential area.

#### STAGING POTENTIAL ✓

##### *Staging of Construction*

The scope for staged construction of a rapid transit alignment in either corridor is limited as each of the corridor lengths are relatively short.

In the Mountain corridor, the section connecting the central area to the development above the Escarpment would have to be completed before rapid transit service could begin. Similarly, in the West Hamilton corridor, the exclusive right-of-way would have to be provided between the central area and Main Street West before any major increase in scheduled speeds could be achieved.

##### *Staging of Priority Surface Transit Improvements*

If a decision is reached to encourage the development of separate right-of-way transit to

reduce the magnitude of the road expansion requirements, parallel transportation policy with respect to parking, parking rates and road improvements should be introduced. The potential for staging the development of transit priorities to attract higher ridership is an important consideration in the gradual implementation of this transportation policy.

While the potential for providing short-term priority measures within either corridor is limited, the Mountain corridor offers the best opportunity. Of the 11 H.S.R. routes crossing the Escarpment, seven routes operate over the Jolley Cut. As this roadway could possibly be expanded by one lane at relatively little cost, the scope to provide an exclusive transit lane appears to warrant consideration.

In the West Hamilton corridor, the Main - King arterial one-way pair are at capacity. The widening of these streets in the short-term planning would be difficult and expensive. Consequently, it does not appear feasible to provide a short-term priority transit lane operation in this corridor.

In the central area, it may be desirable to determine the feasibility of an at-grade transit mall concept at an early stage. The benefits



would be primarily improved schedule adherence due to removing the conflict between transit and auto - truck traffic in the core area. The improvement would benefit the system as a whole as the majority of the system focuses on the downtown core.

#### ENVIRONMENTAL/COMMUNITY IMPACT ✓

An assessment of the potential environmental and community impact which would occur was prepared under the following elements of analysis:

- the potential noise and visual impact on adjacent land use activities;
- the potential property disruption;
- the possible number of neighbourhoods severed by the transit facility;
- the extent to which existing roads could be constrained by the construction and/or operation of the rapid transit system;
- the number and types of sensitive natural areas which could be affected; and
- the potential impact on historic or important architectural sites within the respective corridors.

An analysis based on these criteria provided a comparative measurement of the possible effects of constructing a separate right-of-way transit operation in each of the two corridors.

The study team's conclusion is that there is at most a marginal difference between the alternative corridors in terms of potential environmental and community impact. Flexibility will exist in developing a final alignment to avoid significant cultural features and minimize the disruption of private property and traffic circulation. Further detail related to this assessment is contained in the interim report presented to the Technical Advisory Committee, February 1976.

#### CAPITAL COSTS ✓

The capital costs of construction and property acquisition were prepared based on the selected representative alignments. The mixture of the various types of construction assumed have been outlined previously in this section.

The geometrics assumed and the support system required were based on bus rapid and light rail technologies. However, the permanent tunnel and cut and cover cross sections costed would be capable of accommodating a higher capacity system when required at some point in the future.

A soils investigation was completed as part of this activity to assess the proposed construction from a geotechnical standpoint. The

analysis indicates the construction is feasible and may not require unusually expensive construction techniques. The review also confirmed the feasibility of ultimately providing a subway section in the central area of the City. Further detail is available from the geotechnical report presented to the Technical Advisory Committee in May 1976.

The property cost estimates were prepared by the City Real Estate Department. The preparation of the estimates, particularly with respect to tunnelling construction, were based on the present Toronto experience. All costs are in 1975 dollars and have not been projected to provide for escalation to future construction or operating years.

As outlined in Table 6.3, the estimated capital cost of construction in the Mountain and West Hamilton corridors is \$38.0 M and \$48.0 M, respectively, based on a bus rapid technology. Under a light rail transit operation, the capital costs would rise to \$41.0 M and \$56.0 M, respectively. The increase in cost under light rail transit is due to higher support facility costs and more expensive passengers' terminal facility because of the need to accommodate the feeder bus system.

Table 6.3  
CORRIDOR CAPITAL COST ESTIMATES\*

|                                 | Bus (Diesel) | L.R.T.        |
|---------------------------------|--------------|---------------|
| Central Area:                   |              |               |
| At-grade alignment**            | \$ 2,100,000 | \$ 3,100,000  |
| Underground alignment***        | 23,000,000   | 18,000,000    |
| Property                        | 600,000      | 600,000       |
| West Hamilton Corridor:         |              |               |
| CBD to Main Street West         | \$37,600,000 | \$42,000,000  |
| Ramp connections to Highway 403 | 3,500,000    | 5,000,000**** |
| Shops and Yards                 | 3,000,000    | 5,100,000     |
| Property                        | 3,400,000    | 3,400,000     |
| TOTAL                           | \$47,500,000 | \$55,500,000  |
| Mountain Corridor:              |              |               |
| Graded, Separated Section       | \$32,600,000 | \$30,600,000  |
| Mohawk Road to Rymal Road       | -            | 3,000,000     |
| Shops and Yards                 | 3,000,000    | 5,000,000     |
| Property                        | 2,200,000    | 2,200,000     |
| TOTAL                           | \$37,800,000 | \$40,800,000  |

\*These costs include allowances for contingencies, engineering and agency administration, and utility work other than major utility relocations. They do not include costs of acquiring rolling stock.

\*\*Includes two at-grade stations in the CBD.  
\*\*\*Includes two underground stations in the CBD.

\*\*\*\*Includes allowance for a transfer station in the vicinity of Dundurn Street.



The capital construction costs for the desirable and ultimate Central Area concept are \$18.0 M for a subway alignment. No property estimates were prepared for the subway operation as it would reasonably be co-ordinated with the expansion and redevelopment of the core area. Preliminary analysis indicates the short-term interim at-grade option cost would range between \$2.0 M and \$3.0 M.

The capital costs for the West Hamilton corridor (8,400 feet in length) are higher than the costs for the Mountain corridor (11,200 feet in length). Primarily this is due to the greater length of less costly at-grade construction in the Mountain corridor. The unit costs for each type of construction are given below, together with the length of each section under each alternative.

| Item            | Bus                   | L.R.T.     | Mountain Corridor    | West Hamilton Corridor |
|-----------------|-----------------------|------------|----------------------|------------------------|
|                 | (Dollars per foot)    |            | (Length in feet)     |                        |
| Transit Way:    |                       |            |                      |                        |
| - At-grade      | \$ 170                | \$ 360     | 3,600                | 500                    |
| - Retained Cut  | 760                   | 1,500      | 1,200                | 3,900                  |
| - Elevated      | 1,930                 | 1,800      | 900                  | 1,000                  |
| - Rock Tunnel   | 4,100                 | 3,400      | 4,500                | -                      |
| - Cut and Cover | 4,500                 | 3,500      | 1,000                | 3,000                  |
| Stations:       | (Dollars per station) |            | (Number of stations) |                        |
| - At-grade      | \$ 600,000            | \$ 600,000 | 1                    | -                      |
| - Retained Cut  | 2,000,000             | 2,500,000  | 1                    | 3                      |
| - Underground   | 5,700,000             | 4,800,000  | 1                    | 1                      |

### 6.3 SELECTION OF PRIORITY CORRIDOR

On the basis of the comparative evaluation, the Mountain corridor is clearly the recommended priority corridor for rapid transit in Hamilton. The ridership forecasts are not as dependent on other major transportation decisions as is the West Hamilton corridor. It offers the best potential for reducing the requirement for further road expansion and annual transit operating costs. The degree to which a facility in this corridor could reinforce the current proposals of the long-term development plans for the City also favours its selection.

In absolute terms, it appears clear that a rapid transit facility would reduce the requirement for expansion of the road access across the Escarpment. Present trends indicate that encouraging higher transit usage is a positive step in recognizing the need to provide a more energy efficient urban transportation system.

It will be difficult and expensive both in terms of costs and disruption to expand the road facilities to accommodate the expected increase in travel. The analysis given in this section indicates a rapid transit facility could be provided feasibly without significant disruption of the present residential and commercial development.

The capital costs are significant. However, when compared with anticipated costs of major road improvements, the capital costs are comparable, if not less, to provide higher capacity. In addition, a separate right-of-way transit facility provides a direct benefit by reducing transit operating costs.

The results of this phase of the programme have demonstrated the need for a separate right-of-way transit system in Hamilton given the growth and development options used. The major impact of optional growth strategies will only influence the scheduling of the introduction of rapid transit in Hamilton.

The major factor influencing the potential for rapid transit in Hamilton, given the expected growth in population and employment, is the development of a transportation policy which reinforces the objective of encouraging greater use of public transportation.

The public transportation system will continue to be focused on the central area to provide the most convenient service for the majority of potential users. In our opinion, a complementary transportation policy would restrict major road expansion in the corridors leading to the central area, limit the amount of

core area parking available to employees and place a premium on the use of the parking spaces provided.



# 7. Technology review

*This section of the report describes the capabilities of existing urban transit systems. It concludes with a broad performance specification describing the characteristics of the type of system which would be suitable in the Hamilton area. The performance specifications were based on the anticipated demand and geometric requirements developed during the course of the project.*

Any attempt to select a specific technology for application in Hamilton at this time would be premature. At the time of implementation, the systems available can be assessed using this broad performance specification to take advantage of technology improvements and other considerations which may make some of the present systems impractical.

## 7.1 DESCRIPTION OF EXISTING TECHNOLOGIES

The review began with an examination of the generic classes of technology available for application in Hamilton. To provide comparisons between the various classes of systems, specific technologies were selected from each class. The present status of development was the major criterion in the selection of a representative system to assist in providing a greater amount of factual operating data.

A description of the five major technology classifications follows. The representative system selected for comparison from each classification is identified. The review is summarized in Exhibit 11.

### HIGH-CAPACITY RAPID TRANSIT (HCRT)

This system type is characterized by the rapid transit systems operating in Toronto and Montreal. The system is comprised of heavy rail vehicles operating in trains along exclusive rights-of-way. Power is supplied to the electric motors through a third rail distribution system. The Montreal Metro operates on rubber tires while the Toronto system is a steel-wheel-on-steel-rail type. Trains can be controlled automatically or by railway block signals.

Representative operating and design standards for this classification have been derived from the Toronto system.

### LIGHT RAIL TRANSIT (LRT)

Light rail transit is based on streetcar-type vehicles, manually operated and operating singly or in small trains on an exclusive right-of-way.

Examples of Light Rail Transit are Toronto, San Francisco and Cleveland. The City of Edmonton is presently constructing a 4.5-mile rapid transit line which will use light rail vehicles. Completion is expected by 1978.

Current statistics for these systems have been based on the Canadian Light Rail Vehicle (CLRV) under development by the Urban Transportation Development Corporation. This vehicle has been adopted by Toronto for use as both a streetcar and for Light Rail Transit.

### AUTOMATED GUIDEWAY TRANSIT (AGT)

This technology is an automated guideway system operating at relatively close headways without operators on board the vehicles. This system requires an exclusive right-of-way for operation.

Examples of AGT are the Morgantown System, the Westinghouse Expressway and the Ford ACT System. Most AGT systems are supported on rubber tires. Other support systems such as steel-wheel-on-steel-rail, air suspension and magnetic levitation have been tested.

At the present time, experience with AGT system in urban transit service is limited to the Morgantown operation. A further program of development will be necessary to improve reliability to a level suitable for public transit operations in Hamilton.

#### BUSWAY TRANSIT

A busway is a roadway for the exclusive use of buses. Examples of busways in operation are the Shirley Highway, Washington, D.C.; the El Monte Busway, Los Angeles; and the Lincoln Tunnel between New Jersey and New York. The Region of Ottawa-Carleton has completed a functional study for a 5.5-mile busway linking the Alta Vista area with the Central area of Ottawa.

In most instances, the buses operate along the busway as a trunk haul system and then complete the feeder function on city streets without the need for passengers to transfer.

For comparison purposes, the diesel-powered vehicle was selected. The trolley bus is not as flexible in feeder operations since it requires overhead trolley wires along its route.

#### MONORAIL TRANSIT

Monorail systems such as Alweg and Safage are patented proprietary systems operating on or under a supporting beam. Examples of the monorail systems are to be found in Disneyland, Seattle and Tokyo. The other example of monorail in urban public transit service is the Wuppertal Monorail in West Germany. The system has been in operation for a number of years and is presently being upgraded. Monorail systems have a relatively small guideway which can be constructed at low cost in the elevated attitude. However, the beam is required throughout the system and, in the underground and at-grade situations, the system becomes more costly. The major problem with monorail systems to date has been the cumbersome device required for switching. This problem has resulted in most monorails operating as simple shuttle or loop systems so as to avoid the need for switching in revenue operation.

For comparison purposes, the Alweg monorail has been taken as representative of the monorail systems.



## HIGH CAPACITY RAPID TRANSIT

Heavy rail systems are full-sized rapid transit vehicles operating in trains along exclusive rights-of-way.

## LIGHT RAIL RAPID TRANSIT

Light rail systems are streetcar type vehicles operating singly or in small trains on steel rails generally on exclusive rights-of-way.

## AUTOMATED TRANSIT

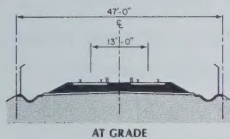
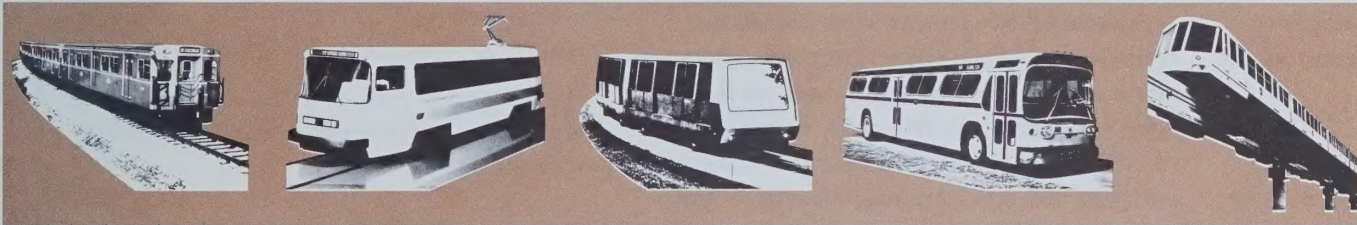
Automated guideway systems are based on the concept of automatic train control. The systems operate in small trains along exclusive rights-of-way.

## BUS RAPID TRANSIT

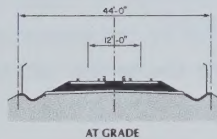
Bus rapid transit assumes the operation of conventional bus or trolley coaches along an exclusive two-lane roadway.

## MONORAIL TRANSIT

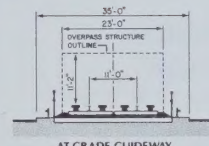
Monorail systems incorporate vehicles running on, or suspended from, a single beam. Guide wheels are required to stabilize and guide the vehicle, which can operate either singly or in trains.



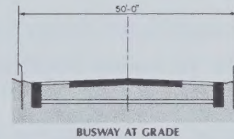
AT GRADE



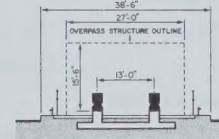
AT GRADE



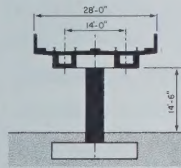
AT GRADE GUIDEWAY  
Westinghouse Skybus



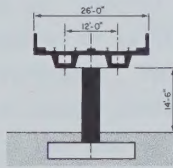
BUSWAY AT GRADE  
With Drains



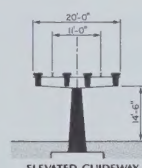
AT GRADE GUIDEWAY  
Alweg Monorail



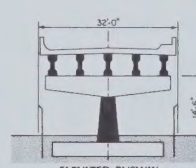
ELEVATED



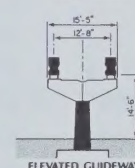
ELEVATED



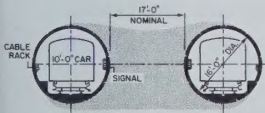
ELEVATED GUIDEWAY  
Westinghouse Skybus



ELEVATED BUSWAY



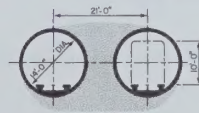
ELEVATED GUIDEWAY  
Alweg Monorail



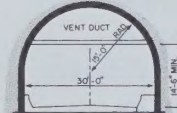
TUNNEL  
Earth or Rock



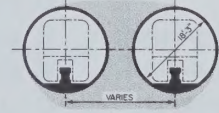
TUNNEL-ROCK



TUNNEL  
Westinghouse Skybus



TUNNEL-ROCK



TUNNEL  
Alweg Monorail

# HAMILTON RAPID TRANSIT DEVELOPMENT PROGRAMME

DE LEUW-DILLON-IBI GROUP

System  
Classifications  
and  
Representative  
Technologies

## 7.2 COMPARISON OF SYSTEM CHARACTERISTICS

The service characteristics, performance statistics, costs and the status of development are described in summary form in Tables 7.1, 7.2, 7.3 and 7.4. The characteristics and costs shown are typical for the representative systems selected. These figures could vary depending on the exact requirements of the selected system for Hamilton.

Table 7.1 shows the service characteristics of rapid transit systems. The service modes given are those which each classification best operates in. Other modes are possible with each system but the service may not be optimum.

Typical physical characteristics of the systems are given in Table 7.2. These are in fact largely characteristics of the vehicles.

Table 7.3 gives typical vehicle and operating costs for various systems. These costs should be examined in conjunction with capital costs for each system.

The status of development for each rapid transit system is described in Table 7.4, together with the examples of where they are in operation. The numbers given for vehicles in service are for North America. There are many more in service in other parts of the world.

## 7.3 BROAD PERFORMANCE SPECIFICATIONS

The performance specifications are based on the experience gained in the operation of present technologies and the particular requirements in the City of Hamilton.

The review of the present technologies has established practical specifications related to performance, passenger comfort and public acceptance. The site-specific needs of Hamilton are related to the anticipated demand requirements and grade and curvature requirements in the corridors studied.

The preliminary performance specifications include the following broad categories:

- a) quality of transportation service
- b) security
- c) safety
- d) reliability
- e) noise level
- f) appearance
- g) maximum speed
- h) flexibility
- i) accessibility
- j) energy requirements
- k) air pollution
- l) capacity
- m) minimum gradient
- n) minimum curvature

Each of the above categories is expanded upon in the remaining section. Table 7.5 indicates a tolerance range for each of these specifications based on the available technologies and the requirements of the City. An explanation of the items covered in the table follows.

### QUALITY OF TRANSPORTATION SERVICE

The quality of ride on a transit system is a qualitative criterion made up of a number of elements:

-Seated or Standing Trip: the number of passengers required to stand on any transit line is a function of the amount of service offered relative to the demand and the seating configuration.

-Dynamic Forces: the passenger's conception of ride quality is influenced by a number of dynamic forces. Acceleration and braking produce longitudinal forces; turning corners produces lateral forces; and irregularities in surface and the suspension system produce horizontal forces. Particularly critical are jerk rates or the rate of change of acceleration in both the longitudinal and lateral directions.



Table 7.1  
SERVICE CHARACTERISTICS OF RAPID TRANSIT SYSTEMS

| System Classification              | Representative Technology | Service Modes                                                    | Flexibility                                         |
|------------------------------------|---------------------------|------------------------------------------------------------------|-----------------------------------------------------|
| High-Capacity Rapid Transit (HCRT) | Toronto Subway            | Line Haul                                                        | Exclusive ROW only                                  |
| Light Rail Transit (LRT)           | UTDC Light Rail           | Line Haul                                                        | Can operate on exclusive ROW or in mixed traffic    |
| Automated Transit                  | Westinghouse Expressway   | Loop/Shuttle Service, Line Haul or Origin-to-Destination Service | Exclusive ROW only                                  |
| Busway Transit                     | Diesel Bus                | Line Haul or Collection/Distribution                             | Can operate on exclusive busway or in mixed traffic |
| Monorail Transit                   | Alweg Monorail            | Loop/Shuttle Operation                                           | Exclusive ROW only                                  |

Table 7.2  
TYPICAL PHYSICAL CHARACTERISTICS OF RAPID TRANSIT SYSTEMS

| Characteristics            | High-Capacity<br>Rapid Transit | Light Rail<br>Transit | Automated<br>Transit | Bus Rapid<br>Transit | Monorail<br>Transit |
|----------------------------|--------------------------------|-----------------------|----------------------|----------------------|---------------------|
| Dimensions                 |                                |                       |                      |                      |                     |
| Length - ft.               | 75.0                           | 51.0                  | 28.0                 | 40.0                 | 90.0 <sup>4</sup>   |
| Width - ft.                | 10.0                           | 8.5                   | 7.0                  | 8.5                  | 10.0                |
| Height Above T/R - ft.     | 12.0                           | 13.0                  | 9.0                  | 10.0                 | 11.0                |
| Weight                     |                                |                       |                      |                      |                     |
| Empty - lbs.               | 60,000                         | 40,000                | 18,000               | 20,500               | 75,000              |
| Crush Load - lbs.          | 110,000                        | 58,000                | 26,000               | 36,000               | 125,000             |
| Performance                |                                |                       |                      |                      |                     |
| Maximum Speed - mph        | 55.0                           | 50.0                  | 45.0                 | 55.0 <sup>1</sup>    | 50.0                |
| Acceleration - mph/sec.    | 2.5                            | 3.0                   | 2.5                  | 2.0 <sup>1</sup>     | 3.0                 |
| Braking Rate - mph/sec.    | 3.0                            | 3.5                   | 3.0                  | 3.0                  | 3.0                 |
| Maximum Grade - %          | 4.0                            | 5.0                   | 6.0                  | 7.0 <sup>2</sup>     | 5.0                 |
| Minimum Curve Radius - ft. | 500.0                          | 40.0                  | 120.0                | 45.0 <sup>2</sup>    | 400.0               |
| Capacity                   |                                |                       |                      |                      |                     |
| Number of Seats            | 80                             | 48                    | 22                   | 50                   | 82                  |
| Crush Load                 | 300                            | 120                   | 54                   | 100                  | 310                 |
| Design Load                | 200                            | 80                    | 36                   | 75                   | 205                 |
| Number of Units in Train   | 6                              | 4                     | 6                    | 1                    | 6                   |
| Number of Trains per hour  | 32                             | 60                    | 72                   | 200 <sup>3</sup>     | 24                  |
| Line Capacity              |                                |                       |                      |                      |                     |
| Seats per hour             | 15,000                         | 11,500                | 9,500                | 10,000               | 11,800              |
| Passengers per hour        | 38,000                         | 19,200                | 15,000               | 15,000               | 30,000              |
| Fuel Consumption           |                                |                       |                      |                      |                     |
| Diesel - MPG               | -                              | -                     | -                    | 5.5                  | -                   |
| Electric - KW.hr/m         | 6.5                            | 4.5                   | 2.0                  | -                    | 7.0                 |
| Operating Methods          |                                |                       |                      |                      |                     |
| Control of Vehicle         | manual or automated            | manual                | automated            | manual               | manual or automated |
| Attendant on Board         | 2/train                        | yes                   | no                   | yes                  | 2/train             |
| Switching                  | railway type                   | railway type          | on-board             | manual steering      | moving guideway     |

1. Standard 6-cylinder engine and transmission. Higher speeds attainable with 8-cylinder engine and overdrive transmission.
2. Outside radius of curve. Other systems are for centreline radius.
3. Assumes busway operation and ability of buses to pass loading vehicles at stations.
4. Monorail of 90-foot length is articulated.



Table 7.3  
TYPICAL COSTS FOR RAPID TRANSIT SYSTEMS

|                                                                   | High-Capacity<br>Rapid Transit | Light Rail<br>Transit | Automated<br>Transit | Bus Rapid<br>Transit | Monorail<br>Transit |
|-------------------------------------------------------------------|--------------------------------|-----------------------|----------------------|----------------------|---------------------|
| VEHICLE COST                                                      |                                |                       |                      |                      |                     |
| Cost per Unit                                                     | 500,000                        | 375,000               | 250,000              | 70,000               | 500,000             |
| Life in Years                                                     | 30                             | 25                    | 15                   | 15                   | 20                  |
| OPERATING COST                                                    |                                |                       |                      |                      |                     |
| Fuel - \$/Vehicle Mile <sup>1</sup>                               | 0.11                           | 0.08                  | 0.03                 | 0.13                 | 0.12                |
| Maintenance of Vehicles -<br>\$/Vehicle Mile                      | 0.35                           | 0.35                  | 0.30                 | 0.27                 | 0.50                |
| Transportation -<br>\$/Vehicle Hour                               | 4.00                           | 11.00                 | 0.50                 | 11.00                | 4.00                |
| Station Operation<br>Attendants - \$/hour                         | 9.20                           | 9.20                  | 9.20                 | 9.20                 | 9.20                |
| Maintenance of Way - \$/ <sup>2</sup><br>Route Mile               | 50,000                         | 30,000                | 12,500               | 12,500               | 50,000              |
| Maintenance of Stations<br>- \$/Station                           | 50,000                         | 40,000                | 30,000               | 35,000               | 50,000              |
| Maintenance of Subsystems <sup>3</sup><br>- \$/Route Mile         | 50,000                         | 40,000                | 100,000              | 5,000                | 50,000              |
| Snow Removal - \$/Route <sup>4</sup><br>Mile                      | 10,000                         | 10,000                | 40,000               | 20,000               | 20,000              |
| General & Administrative<br>- Expenses - % of Other<br>- Expenses | 15.0                           | 15.0                  | 15.0                 | 15.0                 | 15.0                |

1. Fuel cost is based on: electricity at 1.7¢ per KW hr including demand and consumption charges; diesel oil at 70¢ per Imperial gallon.

2. Maintenance of way cost is based on a mixture of elevated, at-grade and underground construction.

3. Maintenance of subsystems based on:  
Diesel Bus - visual signals only.  
Light Rail Transit - visual signals and trolley wires.  
High-Capacity Rapid Transit - block signals and third rail.  
Intermediate-Capacity Transit - automated control, off-line stations and contact rails.  
Monorail - block signals and contact rails.

4. Snow removal cost is based on ploughing, salting and melting as required.

Table 7.4  
STATUS OF TECHNOLOGY DEVELOPMENT IN NORTH AMERICA

|                                         | Status                        | Examples of Systems in Service                                                                            | Vehicles in Service | Development Required for Urban Transit                                            | Development Continuing                             |
|-----------------------------------------|-------------------------------|-----------------------------------------------------------------------------------------------------------|---------------------|-----------------------------------------------------------------------------------|----------------------------------------------------|
| High-Capacity Rapid Transit Steel Wheel | Proven                        | Toronto Subway, BARTD & many other systems                                                                | 10,000              | None                                                                              | Improved Systems. Reduced noise                    |
| Light Rail Transit                      | Proven                        | Toronto, San Francisco, Boston, Philadelphia, Pittsburgh & many European cities                           | 1,500               | None                                                                              | New vehicle designs. Improved operating efficiency |
| Automated Transit                       | No urban transit applications | Dallas - Ft. Worth Airport; Seattle - Tacoma Airport; Bradley Field, Hartford, Conn.                      | 100                 | Improved reliability & control systems. Demonstration in urban service            | System testing in non-urban service                |
| Busway Transit                          | Proven                        | Shirley Hwy., Washington, D.C.; Lincoln Tunnel, New York; El Monte Busway, Los Angeles (all diesel buses) | 1,000+              | Improved structures. Underground stations. Ventilation systems. Reduced pollution | Improved vehicles. Reduced pollution and noise     |
| Monorail Transit                        | Proven in recreation use      | Disneyland and Seattle                                                                                    | 50                  | Improved switch. Demonstration in heavy urban service                             | Limited work                                       |



## APPENDICES







# Appendix 'A' - Index of interim reports

During the course of the project, interim reports were submitted covering the major components of work. These were working documents which outlined the detailed statistics related to the methodology and costing.

| Task | Title of Interim Report                                    | Date of Submission |
|------|------------------------------------------------------------|--------------------|
| 2    | Evaluation Methodology                                     | August 1975        |
| 3    | Assessment of Construction Costs                           | March 1976         |
|      | Preliminary Engineering Assessment of Geotechnical Profile | May 1976           |
| 4    | Inter-regional Transit                                     | November 1975      |
| 5    | Activity Areas                                             | November 1975      |
| 6    | Operating Standards and Costs                              | March 1976         |
|      | Evaluation of Criteria                                     | March 1976         |
|      | Technology Assessment                                      | November 1975      |
| 1&7  | Define Basic Trunk                                         | March 1976         |
| 8    | Priority Corridor Evaluation Methodology                   | January 1976       |
|      | Priority Corridor Evaluation                               | March 1976         |
| 8    | Environmental/Community Impact Assessment                  | March 1976         |





# Appendix 'B' - Public participation

## INTRODUCTION

During this early phase of the Hamilton Rapid Transit Development Programme, the main emphasis of the citizen participation programme was on informing the public of the Study's progress and findings, while at the same time receiving and reviewing ideas and comments from interested citizens. The informal atmosphere of an Open House in which a one-to-one relationship between Study team members and citizens is possible was selected as the most appropriate means of communicating with the public. Thus, the main thrust of the citizen participation programme centred on three Open Houses at the Project Office, 149 Main Street East. The format of the three Open Houses, held in October and December, 1975 and April, 1976 was similar. Information was presented in a series of panels consisting of maps and accompanying text. Four Study team members were in attendance to talk with citizens, answer their specific questions and receive their comments.

## BACKGROUND

In order to inform the public that the present phase of the Hamilton Rapid Transit Study was underway and to advertise the first Open House, approximately 16,000 brochures explaining the purpose of the Study were distributed to various citizen groups and public agencies. Included in

this brochure was a postcard for those interested in requesting information on the Study's progress.

The following is a detailed breakdown of the brochure distribution:

|                                                            |            |
|------------------------------------------------------------|------------|
| Region of Hamilton-Wentworth                               | 500        |
| Hamilton City Hall                                         | 200        |
| Hamilton Public Libraries                                  | 1,000      |
| McMaster University                                        | 400        |
| Mohawk College                                             | 200        |
| Regional Citizens' Groups and Community Agencies (22 x 10) | 220        |
| Elected Representatives (68 x 10)                          | 680        |
| Major Employers (11 x 10)                                  | 110        |
| Wentworth Businessmen's Association                        | 500        |
| Chamber of Commerce                                        | 1,600      |
| Hamilton Automobile Association                            | 50         |
| Hamilton Area Conservation Authority (52 x 10)             | <u>520</u> |
|                                                            | 5,980      |

In addition, 10,000 brochures were placed in the Hamilton Street Railway buses. A record was kept of those who attended the Open Houses and this, together with the brochure postcards and representatives of the above public and private organizations, made up our ongoing mailing list. By the final Open House the list contained approximately 500 people.

## FIRST OPEN HOUSE

The first Open House was held at the Project Office on October 7, 1975 from 10:00 a.m. to 10:00 p.m. Besides the distribution of the brochure, additional promotion included display advertisements in the Hamilton Spectator and local weeklies as well as public service announcements on local radio stations.

The main objective of the first Open House was to introduce citizens to the Study by indicating the issues to be dealt with and the Study approach. Information was presented in a series of 17 panels consisting of illustrative maps and accompanying text under the general headings of:

- Rapid Transit Technology
- Rapid Transit in Hamilton
- Possible Rapid Transit Networks
- Travel Demand and Evaluation Methodology

Approximately 150 people attended the first Open House including representatives from five citizen groups, ten large private companies and five government agencies. Comments from visitors were divided between those who were skeptical of the need for rapid transit in Hamilton and those who were pleased that long-range planning was underway.

EXHIBIT A

| CRITERIA                                                                                                                                                          | EVALUATION         | % DISTRIB. 1<br>RANKING 5 | 2<br>4   | 3<br>3   | 4<br>2   | 5<br>1   | TOTAL      | FINAL<br>RANK |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------------------|----------|----------|----------|----------|------------|---------------|
| A. Passenger Usage<br><br>To attract as many riders as possible by providing a high level of rapid transit service to make the best use of road and bus systems.  | % Distrib. Ranking | 51<br>255                 | 13<br>52 | 9<br>27  | 7<br>14  | 4<br>4   | 100<br>352 | 1             |
| B. To minimize the total capital and operating costs of the City's transit system (including bus service), and costs related to road improvements.                | % Distrib. Ranking | 14<br>70                  | 19<br>76 | 15<br>45 | 19<br>38 | 16<br>16 | 100<br>245 | 3             |
| C. Compatibility<br><br>To minimize disruption of the natural environment and existing neighbourhoods and strengthen the feasibility of future development plans. | % Distrib. Ranking | 20<br>100                 | 19<br>76 | 23<br>69 | 16<br>36 | 6<br>6   | 100<br>287 | 2             |
| D. Construction<br><br>To minimize the disruption during the construction period and the need to acquire property for a rapid transit system.                     | % Distrib. Ranking | 3<br>15                   | 8<br>32  | 13<br>39 | 24<br>48 | 35<br>35 | 100<br>169 | 5             |
| E. Flexibility<br><br>A rapid transit system should be able to respond to various development alternatives.                                                       | % Distrib. Ranking | 11<br>55                  | 20<br>80 | 21<br>63 | 14<br>28 | 17<br>17 | 100<br>243 | 4             |



## SECOND OPEN HOUSE

The second Open House was held on December 15, 1975 from 10:00 a.m. to 10:00 p.m. The purpose of this Open House was to inform citizens of the three rapid transit networks that had been identified and to obtain comments and ideas on the factors which would be used to evaluate the networks.

Publicity for the Open House consisted of two newspaper advertisements in the Hamilton Spectator and notices in five municipal weeklies, public service announcements on three local radio stations and a distribution of a one-page notice. Approximately 3,350 of these notices were mailed or delivered to the previously identified groups as well as the mailing list developed from the first Open House.

Approximately 115 people attended the second Open House. The turnout was slightly less than the first Open House which was attributed to the Christmas season.

New information panels included a comparative chart outlining rapid transit developments in other Canadian cities, population and employment projections based on three alternative growth patterns and the three rapid transit networks which had been identified.

Visitors were asked to fill out an evaluation criteria checklist, rating factors of cost, flexibility, ease of implementation, compatibility with existing land use and passenger usage. (The results of this exercise are contained in Exhibit A.) Although the results of this evaluation exercise were based on a sample of people interested enough to attend the Open House, it did give the Study team an indication of the priorities and concerns of these citizens.

## THIRD OPEN HOUSE

The third Open House was held on April 7, 1976 at the Project Office between 12:00 p.m. and 9:00 p.m. The promotional activity for this last Open House was directed toward press coverage. A half page advertisement was placed in the Hamilton Spectator on April 5th. (This advertisement is shown in Exhibit B.) In addition, a copy of the advertisement was sent to all individuals on the mailing list and to the Region's ten public libraries for posting.

Three new information panels were added to the display: one depicting the two alternatives, a second showing the method of evaluation and, finally, a summary of the corridor evaluation which compared the two alternatives as described in Section 6.

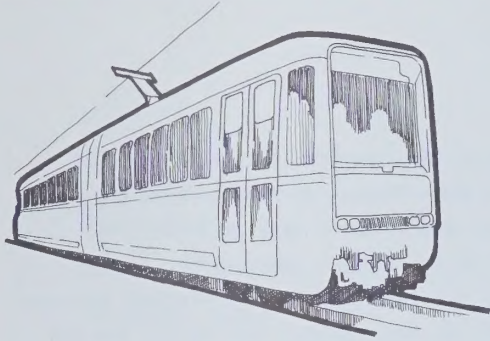
Attendance was somewhat lower than the two previous Open Houses, perhaps because the detailed advertisement gave readers a full account of the Study's conclusions. Consequently, our inference is that citizens who had attended the two previous Open Houses and who were mailed a copy of the advertisement were satisfied. The advertisement did, however, generate a proportionately higher number of new visitors compared with the number of new visitors who attended the second Open House.

## REVIEW OF THE CITIZEN PARTICIPATION PROGRAMME

Visitors to the third Open House were asked to answer an evaluation questionnaire on both the Open House approach to citizen participation and the Study's findings. By far the majority of citizens were satisfied with the Open House concept, although some would have preferred additional written material to take with them. This is particularly important to industrial concerns who want material for their files. Exhibit C indicates the results of the final questionnaire.

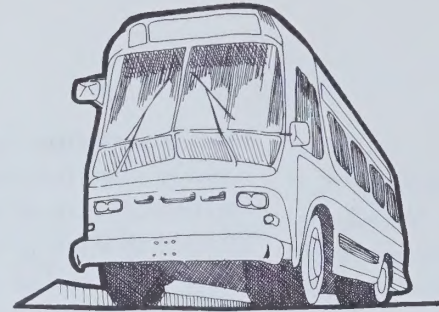
In the final analysis, it is felt that the Open House approach to citizen participation was successful. Certainly citizens seemed to appreciate and take advantage of the opportunity to discuss their specific concerns with Study team members. It should be noted, however, that while





*A link between downtown and the mountain should be the first step in the development of rapid transit for Hamilton. More people living on the mountain, more jobs downtown, more people using transit and increasing traffic problems are the main reasons for this recommendation by a study group hired by the Hamilton Street Railway and other area agencies.*

*Express buses or light rail transit will serve the numbers of riders estimated for the next 25 years. The first steps could include reserved lanes for buses on existing city streets, at little capital cost. Later, a special tunnel for buses or light rail could be built in the mountain-downtown corridor.*



## MOUNTAIN ACCESS FIRST FOR RAPID TRANSIT

### Program Objectives

Since 1969 the HSR and other agencies have been studying future transportation needs for Hamilton. The main purpose of the present phase of the program is to begin planning for rapid transit and to select the area of the City in which the first rapid transit service should be developed. The ultimate objective of the program is to provide convenient and reliable transit service to meet growing demands on the City's transportation system.

### Alternatives Considered

The study team examined all of the major corridors in the Hamilton area. This work started in the summer of 1975 and was reviewed with interested members of the public at two open houses. It was found that the Mountain corridor would have greater volumes of transit riders than the other corridors in the City, and that substantial road congestion would develop in this corridor.

The West Hamilton corridor was found to offer some potential for rapid transit but this potential is dependent to some extent on future commuting volumes between Hamilton and Burlington and on future road programs such as the possible future widening of the Q.E.W. The estimated transit ridership in the West Hamilton corridor would be less than that expected in the Mountain corridor.

Other corridors examined included the industrial area, the King-Main corridor in East Hamilton, and the two corridors between Hamilton and Burlington. Although service improvements will be

necessary in these other corridors in the future, the volumes of transit riders will not be sufficient to support rapid transit during the next 25 years.

### Ridership Estimates

The Regional Planning Department estimates that the population in the Region of Hamilton-Wentworth will increase from 400,000 in 1971 to 480,000 by 1986 and to almost 600,000 by 2001. The number of jobs is expected to double by 2001. An additional 20,000 people will be living on the Mountain by the mid-1980's.

The ridership estimates are based on the expected distribution of people and jobs on the area in 1986 and 2001, and on the relative travel time by road and by transit. The results of surveys in other cities were used to determine the changes in transit ridership that could be expected from the provision of better transit service.

The estimates were checked against the recorded counts of transit riders carried out in the past five years. It was found that the actual ridership in the Mountain corridor has increased substantially during the period 1971-1975.

### Transit Capacities

Normal urban bus services can carry up to about 6,000 passengers per hour per direction. Beyond this volume, special measures are required such as exclusive bus lanes, traffic signal priorities and, ultimately rapid transit in a separate right-of-way.

At present, the Mountain access bus routes serve about 3,300 passengers per

hour in the peak direction. This volume is expected to increase to about 5,500 passengers by the mid 1980's and to 8,000 - 10,000 passengers by the year 2001. In addition, more passengers may be attracted to transit if additional road capacity is not provided on the mountain access routes.

These growth rates suggest that a phased program of transit improvements would be adequate in the Mountain corridor. As ridership approaches the 6,000 passenger threshold special measures could be introduced to expedite bus movements. Later, when the 6,000 passenger threshold is exceeded a special route could be constructed for the exclusive use of transit vehicles. A section of this route could be in tunnel in order to minimize disruption to the escarpment and to ensure reliable service in bad weather.

### Cost Estimates

The potential routes, costs and phasing alternatives will require detailed study in the next stage of the program. Preliminary estimates indicate that the total cost of a special transit way up the Mountain would be in the order of \$40 to \$60 million including a section of tunnel. This cost might be substantially reduced by utilizing or adopting an existing mountain access road to serve as a transit way.

### Benefits

The development of rapid transit in the Mountain corridor would support policies aimed at increasing transit usage in the City and reducing the reliance on private car transport. It is estimated that up to

five more lanes of roadway capacity will be required in each direction for Mountain access by 2001 if today's trends continue into the future. This road requirement could be reduced to 3 lanes or less in each direction if rapid transit is provided in the Mountain corridor.

### Next Steps

The provision of an exclusive route for transit will mean faster bus speeds, more efficient use of transit vehicles, and more convenient transit service. Improvements in the reliability and convenience of transit service in this corridor are key factors in attracting car users to transit.

With the submission of the report on this stage of the work, attention can now focus on the alternatives within the recommended corridor. During the next stage, alternative routes and systems in the Mountain corridor can be examined together with the associated costs and alternative phasing programs for the introduction of better transit services. These steps will ensure the orderly improvement of transit services and the protection of a future rapid transit route.

### OPEN HOUSE

What do you think about rapid transit in Hamilton? Come and talk with the study staff and look at the work which has been done.

149 Main Street East,  
Wednesday, April 7, 1976,  
Noon to 9:00 p.m.

EXHIBIT B



this approach was appropriate for the very general nature of this phase of the programme, future alignment studies will require a more intensive citizen participation programme at the community level.

# EXHIBIT C

How satisfied are you with this way of meeting between citizens and the Study team?

Yes - 31    No - 4

Do you generally agree with the Study's findings?

Yes - 33    No - 4

Where do you live?

|                          |      |
|--------------------------|------|
| On the Mountain          | - 11 |
| East End, below Mountain | - 1  |
| West End, below Mountain | - 10 |
| Central Area             | - 8  |
| Burlington               | - 4  |
| Stoney Creek             | - -  |
| Dundas                   | - 2  |
| Ancaster                 | - 1  |
| Glanbrook                | - -  |
| Flamborough              | - -  |

HAMILTON PUBLIC LIBRARY



3 2022 21335268 1

URBAN